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REPORT OF THE

ROYAL COMMISSION ON COAL

1946

Hon. Mr. Justice W. F. Carroll, *Chairman*
Mr. Angus J. Morrison
Hon. Mr. Justice C. C. McLaurin

OTTAWA
EDMOND CLOUTIER, C.M.G., B.A., L.Ph.,
KING'S PRINTER AND CONTROLLER OF STATIONERY
1947

Rt. Hon. Clarence D. Howe, P.C., M.P.,
Minister of Reconstruction and Supply,
Ottawa.

Dear Mr. Howe:—I have the honour to transmit herewith the report of the Royal Commission on Coal pursuant to the Order of His Excellency the Governor General in Council dated October 12, 1944, P.C. 7756.

The Commission held public sittings in all the provinces of Canada. Visits were made to most of the coal fields in Canada, and to some of the fields in the United States. Complete co-operation and assistance was given to the Commission by officers of the Dominion, provincial and municipal Governments, and particularly by officers of the Department of Mines and Resources and Coal Control. We are also grateful for much valuable assistance from many organizations who submitted briefs, and from representatives of coal operators, trade unions, Canadian and American railways, chemical, petroleum and hydro-electric industries, and the coal distribution trade.

The work of the legal, secretarial, and research staff of the Commission has been of high order and we wish to express to them our appreciation. I would mention in particular the work of our secretary, Robert D. Howland, and our economist, R. W. Lawson.

Yours faithfully,
W. F. CARROLL,
Chairman.

Ottawa,
December 14, 1946.

FOREWORD

In pursuance of its terms of reference the Commission inquired into all aspects of the supply and use of coal in Canada. The result is presented in the various chapters of this report. Much of the work proved technical, but we have tried throughout to write for the benefit of those who have no specialized knowledge on these matters. Some of the chapters contain suggestions in the nature of recommendations, but the main recommendations as to a Federal coal policy are found in the final chapter.

PRIVY COUNCIL

CANADA

Certified to be a true copy of a Minute of a Meeting of the Committee of the Privy Council, approved by His Excellency the Governor General on the 12th October, 1944.

The Committee of the Privy Council have had before them a report, dated October 3, 1944, from the Minister of Munitions and Supply, representing that in his opinion it is expedient in the public interest that a full inquiry be made into the coal industry in Canada.

The Committee, therefore, on the recommendation of the Minister of Munitions and Supply, advise,—

1. That the Honourable Mr. Justice W. F. Carroll of the City of Halifax, in the Province of Nova Scotia, Mr. Angus J. Morrison of the City of Calgary, in the Province of Alberta, and the Honourable Mr. Justice C. C. McLaurin of the City of Calgary in the Province of Alberta, be appointed Commissioners under Part I of the Inquiries Act, Chapter 99 of the Revised Statutes of Canada, 1927, to inquire into and report upon the problems of and matters pertaining to the coal industry in Canada, having regard, generally, to pre-war, present and anticipated post war conditions and the probable future development of Canada;

2. That the Commissioners be authorized to have, exercise and enjoy all the powers conferred upon them by Section 11 of the said Inquiries Act, and that any person deputed by the Commissioners to inquire into any matter within the scope of the Commission, as may be directed by the Commissioners, be authorized to have and exercise the same powers which the Commissioners have, to take evidence, issue subpoenas, force the attendance of witnesses, compel them to give evidence and otherwise conduct the inquiry;

3. That the Honourable Mr. Justice W. F. Carroll be Chairman of the Commissioners;

4. That the Commissioners make their report and recommendations with the least possible delay; and

5. That the Departments of the Government Service of Canada afford the Commissioners and all persons acting under their authority or by their direction, such assistance and co-operation in the matters of the inquiry as the Commissioners may think desirable.

"A. D. P. HEENEY,"
Clerk of the Privy Council

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"A. D. P. HEENEY,"

Clerk of the Privy Council.

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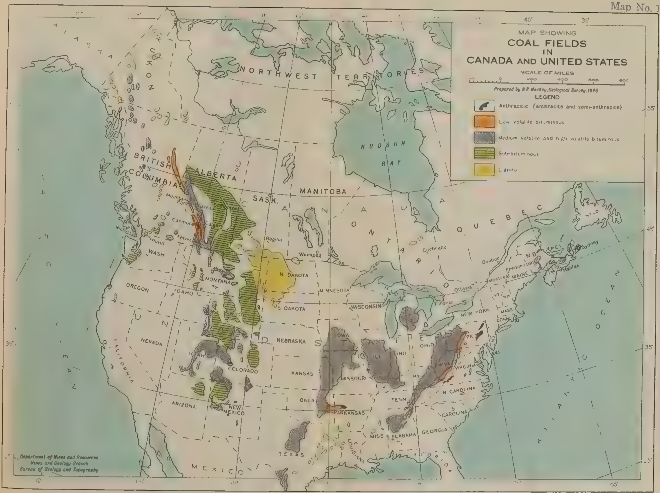
MAP SHOWING
COAL FIELDS
IN
CANADA AND UNITED STATES
SCALE OF MILES
0
200
400
600
Prepared by B R MacKay, Geological Survey, 1946
LEGEND
Anthracitic (anthracite and semi-anthracite)
Low volatile bituminous
Medium volatile and high volatile bituminous
Sub-bituminous
Lignite
Department of Mines and Resources
Mines and Geology Branch
Bureau of Geology and Topography
ALASKA
YUKON
NORTHWEST TERRITORIES
HUDSON BAY
BRITISH COLUMBIA
ALBERTA
SASK.
MANITOBA
ONTARIO
QUEBEC
CANADA
Edmonton
Calgary
Canmore
Fernie
Vancouver
Victoria
Regina
Winnipeg
Cochrane
Quebec
Montreal
Ottawa
Toronto
Fredericton
N.B.
P.E.I.
Sydney
Halifax
WASH
OREGON
IDAHO
MONTANA
N DAKOTA
S DAKOTA
MINNESOTA
WISCONSIN
NEW YORK
MASS
CONN
VT
MAINE
NEVADA
CALIFORNIA
UTAH
WYO
COLORADO
NEBRASKA
IOWA
ILL
IND
OHIO
PA
W.VA
VIRGINIA
DEL
KANSAS
MISSOURI
KY
TENN
N CAROLINA
S CAROLINA
ARIZONA
NEW MEXICO
OKLA
ARKANSAS
MISS
ALABAMA
GEORGIA
FLORIDA
TEXAS
LOUISIANA
MEXICO
UNITED STATES
PACIFIC OCEAN
ATLANTIC OCEAN
45°
35°
55°

CHAPTER I

COAL RESERVES

This chapter is divided into three sections. The first section deals in general terms with the origin and classification of coals and the relation of the various characteristics of coals to their use. In the second section previous estimates of Canadian coal reserves and the basis of the estimate prepared for this Commission are discussed. Canadian reserves are then reviewed from a national point of view followed by more detailed description and discussion of the provincial coal fields. The final section deals with some aspects of the world supply of coal with particular reference to the coal reserves of countries which normally supply the Canadian market.

ORIGIN AND CLASSIFICATION OF COAL

Origin of Coal

Coal may be defined as plant or vegetal matter which, after millions of years of burial and through the action of chemical agencies and heat and pressure, has been converted into a compact mineral fuel. More specifically, the cellulose, lignin and resin constituents, the principal contents of the original vegetal matter, have been subjected to a number of chemical and physical changes involving a loss of moisture and volatile constituents composed of oxygen, hydrogen and carbon, some re-arrangement in the molecules of the remaining constituents and an increase in the proportion of fixed carbon and ash. The maturity of a coal is related to the degree it has undergone these processes, the more highly developed coals having less moisture and volatile constituents and a higher percentage of fixed carbon than the less mature coals. The ash of a coal is mineral matter which comes partly from the plants themselves and partly from the sediment carried by wind or water into the swampy basins where the plant and forest vegetation grew or accumulated before being buried to form a coal seam. Thus, the ash content of a coal is largely accidental and has no relation to maturity except in so far as the loss of moisture and volatile constituents increases the proportion of the ash to the total of the coal constituents. Coal then consists essentially of moisture, fixed carbon, volatile matter and ash but the proportions of these constituents vary according to its state of development. Any considerable differences in the vegetal matter from which the coal substance was formed or in the sediment from which its ash content is derived are reflected in the chemical and physical properties of a coal. As coal deposits have been formed in widely separated areas and under a variety of conditions, coals differ widely in characteristics. This diversity of characteristics has necessitated standardized analyses and classification of coals.

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Classification of Coal

It is probably true to say that there are as many ways of classifying coal as there are uses to which it is put. Until recently, no uniform standards of analysis and classification existed even on the North American Continent; for example, coals having substantially the same physical and chemical composition and heat value were designated differently in Canada and the United States. Difficulties arising from this divergence in classification, especially apparent in applying tariff regulations governing the importation and exportation of coal between the two countries, emphasized the long felt necessity for the development of a uniform and scientific classification of coals on the American Continent. In 1928 the National Research Council set up an "Associate Committee on Coal Classification and Analysis". The Committee was composed of representatives of the Federal Department of Mines and provincial authorities, and professional and industrial specialists. Work was carried on in close association with an earlier formed sub-committee of the American Society for Testing Materials and the American Standards Association, which was concerned with the same problem. After nearly ten years of united effort, a uniform system of classification was evolved and was later approved by both the American and Canadian Committees. Full particulars of this system appear in a report on "The A.S.T.M. Standard Specifications for Classification of Coals by Rank and by Grade and their Application to Canadian Coals" issued by the National Research Council in June, 1939, as N.R.C. No. 814. Under the A.S.T.M. system, coals are classified by standard tests and analyses according to Rank, Grade, Type and Use.

Rank classification, broadly speaking, identifies the degree of maturity of coals or the extent to which they have progressed in the process of alteration from the original vegetal matter, the different classes and groups indicating the various stages of metamorphism through the series peat, lignite, sub-bituminous, bituminous and anthracite. It is essentially a scientific classification based on the chemical properties of the coals and is considered fundamental as other classifications can be based on it. Rank classification is based on the fixed carbon percentage and the calorific value of the coal calculated on a mineral-matter-free basis (ash free). The higher rank coals are classified according to the percentage of fixed carbon on a dry basis whereas the lower rank coals (containing less than 69 per cent fixed carbon) are classified according to B.t.u. per pound on the moist (as mined) basis. When lower rank coals are marginal between bituminous and sub-bituminous, those which will withstand exposure to air without crumbling or slacking (non-weathering coals) and/or tend to cake (agglomerate) on burning are automatically raised in classification to the bituminous rank. Higher rank coals, marginal between bituminous and semi-anthracite, are delimited according to their agglomerating properties. Coals having the other properties of semi-anthracite but showing agglomerating properties are lowered in classification to low volatile coal, the highest group of the bituminous class. The four classes and thirteen groups and their delimiting factors according to the A.S.T.M. system of classification by rank are indicated in the following table.

CLASSIFICATION OF COALS BY RANK

(A.S.T.M. Designation: D.388—38)—1937

Class	Group	Limits of Fixed Carbon or B.t.u., Mineral-Matter-Free Basis	Requisite Physical Properties
I. Anthracite	1. Meta-anthracite	Dry F.C., 98 per cent or more.	
	2. Anthracite	Dry F.C., 92 per cent or more and less than 98 per cent.	
	3. Semi-anthracite	Dry F.C., 86 per cent or more and less than 92 per cent.	Non-agglomerating[1].
II. Bituminous[3]	1. Low volatile bituminous coal.	Dry F.C., 78 per cent or more and less than 86 per cent.	
	2. Medium volatile bituminous coal.	Dry F.C., 69 per cent or more and less than 78 per cent.	
	3. High volatile A bituminous coal.	Dry F.C., less than 69 per cent and moist[2] B.t.u. 14,000[4] or more.	
	4. High volatile B bituminous coal.	Moist[2] B.t.u. 13,000 or more and less than 14,000.	
	5. High volatile C bituminous coal.	Moist B.t.u. 11,000 or more and less than 13,000[4].	Either agglomerating or non-weathering[5].
III. Sub-bituminous	1. Sub-bituminous A coal.	Moist B.t.u. 11,000 or more and less than 13,000[4].	Both weathering and non-agglomerating[5].
	2. Sub-bituminous B coal.	Moist B.t.u. 9,500 or more and less than 11,000[4].	
	3. Sub-bituminous C coal.	Moist B.t.u. 8,300 or more and less than 9,500[4].	
IV. Lignitic	1. Lignite	Moist B.t.u. less than 8,300.	Consolidated.
	2. Brown coal	Moist B.t.u. less than 8,300.	Unconsolidated.

[1]If agglomerating, classify in low-volatile group of the bituminous class.
[2]Moist B.t.u. refers to coal containing its natural bed moisture but not including visible water on the surface of the coal.
[3]It is recognized that there may be non-caking varieties in each group of the bituminous class.
[4]Coals having 69 per cent or more fixed carbon on the dry, mineral-matter-free basis shall be classified according to fixed carbon, regardless of B.t.u.
[5]There are three varieties of coal in the high-volatile C bituminous coal group, namely, Variety 1, agglomerating and non-weathering; Variety 2, agglomerating and weathering; Variety 3, non-agglomerating and non-weathering.

Grade classification is devised to indicate, from a commercial standpoint, the principal properties of a coal as marketed. It covers calorific value, amount and nature of the ash, sulphur content and size. No name is attached to any grade so that this form of classification may be said to provide a single and uniform system by which the coal operator or dealer may specify the coal tendered. As compared with rank classification, the emphasis of grade classification is on the nature and amount of the ash content of the coal. Thus, the analyses in this instance are expressed on the basis of coal as sampled or received rather than adjusted to the mineral-matter-free basis as in the first instance. The calorific value of any coal on the "as received" basis obviously will be lower than when adjusted to either the "mineral-free" or "dry mineral-free" basis employed in rank classification, and it is important to be assured that calorific value analyses of different coals are calculated on a similar basis when making comparisons. It should be noted perhaps at this point that the grade of a coal can be, and often is, improved by preparation for the market. Beneficiation, on the other hand, will not affect the rank of a coal. The tables which follow show the symbols for grading coal according to ash, softening temperature of ash and sulphur, as per A.S.T.M. standard specifications, and the symbols for size designation, as tentatively specified by the Canadian Government Purchasing Standards Committee.

SYMBOLS FOR GRADING COAL ACCORDING TO ASH, SOFTENING TEMPERATURE OF ASH, AND SULPHUR (ANALYSIS EXPRESSED ON BASIS OF THE COAL AS SAMPLED).

(A.S.T.M. Designation: D.389—37)—1937.

Ash[1]		Softening Temperature of Ash[2]		Sulphur[1]	
Symbol	Per cent[3] inclusive	Symbol	°F. inclusive	Symbol	Per cent inclusive
A 4	0.0 to 4.0	F28	2800 and higher	S0.7	0.0 to 0.7
A 6	4.1 to 6.0	F26	2600 to 2790	S1.0	0.8 to 1.0
A 8	6.1 to 8.0	F24	2400 to 2590	S1.3	1.1 to 1.3
A10	8.1 to 10.0	F22	2200 to 2390	S1.6	1.4 to 1.6
A12	10.1 to 12.0	F20	2000 to 2190	S2.0	1.7 to 2.0
A14	12.1 to 14.0	F20−	Less than 2000	S3.0	2.1 to 3.0
A16	14.1 to 16.0	....	....	S5.0	3.1 to 5.0
A18	16.1 to 18.0	....	....	S5.0+	5.1 and higher
A20	18.1 to 20.0	....	....	....	....
A20+	20.1 and higher	....	....	....	....

[1] Ash and sulphur are reported to the nearest 0.1 per cent by dropping the second decimal figure when it is 0.01 to 0.04 inclusive, and by increasing the percentage by 0.1 per cent when the second decimal figure is 0.05 to 0.09 inclusive. For example, 4.85 to 4.94 per cent, inclusive, is considered to be 4.9 per cent.

[2] Ash-softening temperatures are reported to the nearest 10 F°. For example, 2635 to 2644° F. inclusive, is considered to be 2640° F.

[3] For numerical grading of coals, ranges in the percentage of ash smaller than 2 per cent are commonly used.

SYMBOLS OF SIZE DESIGNATIONS AND CUSTOMARY TRADE TERMS

(Specification for Coal No. 18-GP-1-1940 Canadian Government Purchasing Standards Committee)

Size Designation	Size Limits (round-hole screens)[1]	Customary Trade Designation[2]
A	Retained on ⅛ inch screen[3]	Run-of-mine or dock-run
B	Retained on 1½ inch screen[3]	Lump
C	Passing 3 inch, retained on 2½ inch screen[4]	Egg
D	Passing 2½ inch, retained on 1½ inch screen[4]	Stove
E	Passing 2 inch, retained on 1/16 inch screen	Nut slack
F	Passing ¾ inch, retained on 1/32 inch screen	Slack
G	Passing 1½inch, retained on ¾ inch screen	Stoker nut
H	Passing ¾ inch, retained on ⅜ inch screen	Stoker pea
J	Passing 9/16 inch, retained on 5/16 inch screen	Buckwheat No. 1 (blower)
K	Passing 5/16 inch, retained on 3/16 inch screen	Buckwheat No. 2 (blower)
L	Passing 3/16 inch, retained on 3/32 inch screen	Buckwheat No. 3 (blower)

[1] Not more than 15 per cent by weight of the sample may pass the screen defining the lower size limit and not less than 95 per cent may pass that defining the upper size limit.

[2] Owing to variations in trade designations this column is given as a convenience only: the alphabetical designation given in the left-hand column governs.

[3] The purchaser may specify a maximum permissible size, in which case not less than 95 per cent of the coal shall pass the screen indicated.

[4] The purchaser may specify another maximum permissible size, in which case not less than 95 per cent of the coal shall pass the screen indicated.

Type classification emphasizes the geological approach in the analysis of coals, and relates particularly to the segregation of coals according to the nature of the material from which the coal was originally formed. It separates such coals as Splint, Cannel and Boghead coals which are thought to have been formed principally of aquatic organisms, both plant and animal, from the ordinary coals formed from terrestrial plant life. These factors affect the characteristics of coals, and when further advanced, this method of classification may have important practical application. At the present time, type classification has little practical importance.

As suggested in the title, classification by use seeks to relate other forms of classification to the actual use of coal for specific purposes. It should be noted, however, that those concerned with the preparation of A.S.T.M. specifications

were unable to agree on definite standards after some years of careful study. Their efforts were frustrated by the many variants which entered into the calculation relating not only to the wide variation of coals but also to the diversity of existing combustion and other equipment and the overwhelming importance in many instances of cost factors. Price differentials may allow a coal of a lower grade and less appropriate rank to be used perhaps with lower efficiency but still at an economic advantage to the user in place of a more desirable but more expensive coal.

Certain properties of coals are of fundamental importance in the consideration of the commercial value of coal. Some of these are related to its rank or grade but others are not. Some indication of these properties at this time will be useful to our general purpose of discussing coal reserves and may serve as background for later consideration of the question of coal marketing and utilization.

1. *Calorific Value.*—For practical purposes, one of the most important properties of a coal is its calorific value, which may be defined as the amount of heat developed by the combustion of a unit weight of the coal. It is usually expressed in terms of B.t.u./pound. As previously suggested, the calorific value of a coal is calculated on an as received basis when measured for the purposes of grade classification, and adjusted for ash and moisture in respect to rank classification. Generally speaking, the higher rank coals have a higher calorific value. In practice, a high percentage of fixed carbon and low percentage of ash and moisture results in a high calorific value. It should be noted perhaps that when calculated on the dry mineral-free basis, coals above the rank of low volatile bituminous tend to decline in calorific value indicating that the maximum heat value of a coal results where the fixed carbon and volatile matter are most effectively balanced rather than in those coals having the highest percentage of fixed carbon.

2. *Ash Content and Fusibility.*—The ash content of a coal is important from the point of view of both the amount of ash and its nature. High ash content means reduced calorific value per unit weight of coal, and thus will be important not only in operation but also in the economics of long distance transportation. In addition, ash handling is important to the consumer from the point of view of inconvenience and possibly of cost. With suitable combustion equipment, a comparatively high ash content may not seriously affect the thermal efficiency of utilization. It should be noted perhaps that coals with a very low ash content may fail to give the required protection to grates normally provided by ash. The importance of the nature of the ash relates particularly to the temperature at which the ash tends to fuse or clinker. Coals are said to have a high, medium or low fusion point of ash according to whether the ash fuses within the following ranges:

Low fusion point of ash	Below 2200° F.
Medium fusion point of ash	2200° F. to 2600° F.
High fusion point of ash	Above 2600° F.

Unless suitable combustion equipment has been installed, a coal with a low fusion point of ash cannot be used for steam raising purposes where high boiler temperatures are required. On the other hand, a certain degree of clinkering is desirable in coals used in domestic underfeed stokers and in this instance a low fusion point of ash may be a positive factor in the selection of a coal.

3. *Volatile Matter.*—The volatile matter is the portion of the coal other than moisture that is driven off as gas or vapour when heated. For some purposes, it is desirable to select coals having a low proportion of volatile matter, especially where the coal is to be used in hand-fired equipment with natural draft or for blacksmithing as the low volatile coals burn more steadily and are less smoky. On the other hand, in the manufacture of gas in vertical retorts certain high volatile coals command a premium as they produce a maximum proportion of gas.

4. *Sulphur Content.*—The sulphur of coal is usually distributed between the organic (pure coal) material and the ash. For general purposes, the quantity of sulphur present in the coal, unless it is very high, has limited practical importance. However, in the production of manufactured gas and metallurgical coke, the sulphur content becomes of primary significance. Rigid restrictions are imposed on the permissible sulphur contents of gas distributed by commercial gas companies while in metallurgy sulphur has a harmful effect unless eliminated and this is a costly process.

5. *Coking.*—The terms coking and caking are sometimes used synonymously in technical literature relating to coal. Efforts are now being made to distinguish the terms and confine the use of the term "coking" to coals which can be employed in the manufacture of coke for metallurgical or domestic purposes. Caking is an overall term and refers to the tendency of coals to coalesce and form either a cake or a coke-like structure when heated, whereas coking is confined to coals which form a cellular coke-like structure when heated. The requisite properties of a coal which determine its suitability for use in the manufacture of coke are discussed in the chapter on Products and By-Products where the coke and gas industry is reviewed. It is sufficient at this time to indicate that coking properties relate closely to rank and grade.

6. *Structure.*—The structure of a coal has importance from several points of view. As suggested in rank classification, certain coals of the lower ranks tend to crumble or slack when exposed to the air. Non-weathering properties of a coal affect its storage and transportation as such coals will disintegrate if transported or stored exposed to the weather. Such coals are also liable to spontaneous combustion when stored in any quantity. Many coals also crumble or slack when handled, in which case they are said to be friable. Friability, however, unlike weathering characteristics, has little direct relation to rank. It is more related to the geology of the coal and the conditions under which the coal matured. This factor of friability is important in both mining and marketing as coals which are friable cannot be readily extracted in domestic sizes while larger sized coals tend to break down when transhipped (degradation). The structure of a coal is also of importance in respect to crushing and pulverizing coals for various uses. When coal is pulverized before use, its resistance to pulverization (grindability) becomes an important factor in coal selection as the cost and ease of grinding will vary according to the grindability index of the coal.

7. *Burning Characteristics.*—The burning characteristics of coals vary with the coal and the combustion equipment utilized, and for this reason few objective standards have been established. Although no sharp boundaries can be drawn between the burning characteristics of the different ranks of coals, some generalizations can be made. Thus it can be said that anthracite commands a premium when burned in hand-fired equipment with natural draft because whereas it ignites slowly, it burns continuously with a minimum of attention and is a clean almost smokeless fuel. The bituminous coals, as the volatile matter increases, tend to produce soot and smoke when burned in this type of equipment because the hydro carbons in the volatile matter do not burn freely. Increased combustion space and different methods of firing are essential to ensure satisfactory combustion of such coals. The sub-bituminous and lignite coals produce little or no smoke as the volatile matter contains more oxygen thus facilitating combustion. Increased combustion space is also necessary in this instance as additional fuel must be burned owing to the low heat value of these coals. In respect to automatic equipment with forced draft, these burning characteristics are less important as they are then more subject to control. Cost factors and the other properties of the coal such as fusion point of ash then assume increasing importance although rigid smoke regulations may still place a premium on what are called smokeless coals.

The inter-relation of many properties of a coal in its commercial evaluation is forcefully illustrated in the selection of coals for railway locomotive purposes. Dealing with the matter of price differentials between various coals, a representative of the Canadian National Railways stated to the Commission;

"There is, of course, some objection to fixing differentials solely on a calorific basis since these figures alone do not necessarily determine the performance of a particular coal on locomotives and its actual value to the Railway. Size and structure of the coal, and fusion point of the ash are also important. Some coals will perform satisfactorily on short runs, but, because of clinkering characteristics, etc., are unsatisfactory for long runs. Other coals are so fine in structure that stack losses are excessive, and more coal is consumed than would be indicated by the analysis of the coal. The C.N.R. could not, therefore, agree to calorific value alone as necessarily being a sound basis of comparison for the purchase of its coal; on which account running tests are made from time to time to determine the value of the various coals in actual service."

In view of the importance of these various characteristics of coal, a number of standard chemical analyses and physical tests have been developed on the basis of which coals are classified in a number of ways. The usual analysis applied is what is known as the proximate analysis. This comprises determinations for moisture, ash and volatile matter contents with the fixed carbon percentage obtained by the difference. Such an analysis does not include the components of the volatile matter or the ash, the fusion point of ash, calorific value, physical characteristics such as its coking, friability, grindability, weathering or slacking properties. Determinations of the carbon, hydrogen, nitrogen and oxygen elements in the coal and sulphur content are made in what is known as the ultimate analysis while specific tests are performed to cover the other characteristics. In practice, the determinations of the proximate analysis are sufficient for day-to-day commercial transactions as coals in any field do not vary to any great extent in respect to the characteristics determined by the more complete analyses, and once these have been established, there is no great necessity to repeat the tests at short intervals. It is customary in giving general information as to coals to quote what is commonly called a typical analysis which includes the results of the proximate analysis and sulphur, fusion point of ash and calorific value determinations. It would appear as follows for, say, coals of the Cascade area, Alberta:

	(As received basis)	
Moisture	Per cent	1.5
Volatile Matter	Per cent	12.8
Fixed Carbon	Per cent	77.5
Ash	Per cent	8.2
Sulphur	Per cent	0.7
Calorific Value	B.t.u./lb.	13,910
F.P.A.	°F.	2850+

It is evident that the Fuels Division of the Federal Department of Mines and Resources and various provincial authorities have contributed effectively to the development of standard tests and analyses of coal and we note with pleasure that their American colleagues have been most generous in their appreciation of the contribution of Canadian scientists to the development of the A.S.T.M. standard specifications. Very considerable application of these tests has been made by these organizations with the result that valuable data are now available concerning the physical and chemical characteristics of Canadian coals.

CANADIAN COAL RESERVES

The location of Canada's coal deposits is shown on Map 1 which prefaces this chapter. Some particulars of the geology of the various Canadian coal deposits are given in later pages when reserves are discussed by provinces.

Very complete data are available concerning most of the coal fields in reports published by the Federal Department of Mines and Resources. The provincial authorities have also published some very instructive reports on a number of fields.

In succeeding pages and throughout the report, Canadian coals are classified by rank according to the A.S.T.M. specifications. It should be noted that reports from the Dominion Bureau of Statistics have retained the old classification. As a result, some discrepancies may appear between the statistics used by this Commission and those published by the Dominion Bureau. For example, coals reported by the Dominion Bureau as lignites are referred to by the Commission as sub-bituminous coals, the rank they achieve under the A.S.T.M. classification. The Commission understands that the Dominion Bureau of Statistics is adopting the A.S.T.M. classification. We think that this step is commendable.

ESTIMATES OF RESERVES

The most widely known and, in fact, the only Canadian-wide estimates of coal reserves in Canada available for the Commission were those prepared by Dr. Dowling in 1913. With Dowling playing a leading role, the International Geological Congress which met in Canada that year made an ambitious attempt to correlate information as to the location and extent of the coal resources of the world. At that time it was estimated that Canada's reserves of coal, including seams one foot and over to the depth of 4,000 feet, and including all ranks of coal, were 1,216,770,310,000 metric tons (2,205 pounds per ton). This figure included what Dowling termed "actual reserves" (those calculated on the basis of actual thickness and extent of seams) and "probable reserves" (including coal where an approximate estimate only could be given). Further details of this estimate appear in the following table.

SUMMARY TABLE OF DOWLING'S ESTIMATES OF COAL RESERVES INCLUDING SEAMS ONE FOOT AND OVER TO DEPTH OF 4,000 FEET, IN THOUSANDS OF METRIC TONS (2,205 LBS. PER TON)

Province	Rank of Coal	Actual Reserves	Probable Reserves	Total by Rank	Total, All Ranks
Nova Scotia	Bituminous	2,188,151	4,891,817	7,079,968	7,079,968
New Brunswick	Bituminous	....	151,000	151,000	151,000
Ontario	Lignite	....	25,000	25,000	25,000
Manitoba	Lignite	....	160,000	160,000	160,000
Saskatchewan	Lignite	2,412,000	57,400,000	59,812,000	59,812,000
Alberta	Lignite	382,500,000	491,271,000	873,771,000	
	Bituminous	3,223,800	182,183,600	185,407,400	
	Anthracite	669,000	100,000	769,000	1,059,947,400
British Columbia	Lignite	60,000	5,136,000	5,196,000	
	Bituminous	23,771,242	44,907,700	68,678,942	73,874,942
Yukon	Lignite	....	4,690,000	4,690,000	
	Bituminous	....	250,000	250,000	4,940,000
Northwest Territories	Lignite	....	4,800,000	4,800 000	4,800,000
Arctic Islands	Bituminous	....	6,000,000	6,000,000	6,000,000
Totals	....	414,804,193*	801,966,117	1,216,770,310*	1,216,770,310*

* In these totals 20,000,000 metric tons has been deducted for the amount of coal of all classes already extracted in Alberta.

In his estimate, Dowling included a total of 26,219.21 square miles for his calculation of actual reserves and 82,662.5 square miles covering probable reserves. It should perhaps be noted that, in addition to this estimate, Dowling gave figures on coal reserves, including seams of two feet and over at depths between 4,000 and 6,000 feet. This added a further 17,499,000,000 metric tons to those previously quoted and covered an additional 287 square miles.

Dowling's estimate cannot be taken as a basis of discussion of Canadian coal reserves. Subsequent geological surveys, drilling programs and the exploration of various coal fields by actual mining operations have disproven a number of his assumptions in regard to the areal extent of the fields and the continuity of seams. From this point of view alone, his estimates would have to be scaled down very considerably. At the same time it is readily apparent that Dr. Dowling's estimates, as he himself realized, were not confined to reserves of what might be termed "mineable coal." If corrected according to the latest geological information, Dowling's estimate might be considered a reasonable approximation of coal occurring as a geological phenomenon in Canada. Under no circumstances could his estimate be considered as an approximation of reserves of coal which, assuming present mining techniques, are physically available without exceptional engineering problems and prohibitive mining costs.

During the course of the Commission's enquiry, considerable evidence as to coal reserves was received. This came principally from the provincial authorities and the coal operators' associations. In addition, the principal operators were asked to provide estimates of coal reserves covering the coal lands which they held. Subsequently these data were submitted to Dr. B. R. MacKay of the Federal Department of Mines and Resources for review.

On the basis of these data and the very considerable information at his disposal at the Geological Survey, Dr. MacKay prepared for the Commission an estimate of Canadian coal reserves. In the course of this work, geological maps covering all the important coal areas in Canada were prepared, including those which appear in this report. As an example of the detailed work undertaken for this estimate, twelve maps (each relating to a single coal seam) of the Sydney coal field in Nova Scotia and fifty maps of Alberta were prepared. Hand-prepared copies of these maps are available for a small charge from the Geological Survey, but we are of the opinion that these maps should be published in an appropriate form by the Department of Mines and Resources as soon as possible.

It is readily apparent that estimates of coal reserves will depend very largely on the yardstick which is employed. From a practical point of view, the yardstick applied by Dowling is valueless. In the past, no coal one foot thick has been mined in Canada below a depth of five hundred feet, and it is extremely unlikely that it will be within the next few decades. This completely invalidates estimates based on coal seams one foot thick and over to the depth of 4,000 feet. It was most apparent from the evidence that a variety of yardsticks had been applied by the various provincial authorities and the operators in measuring the coal reserves of the various fields in Canada and that this was the result of varying mining conditions and economic circumstances in the different areas. What appeared to be an inconsistency was usually in fact a reflection of a highly practical approach, for many factors enter into the determination of what might be termed mineable coal and these will often vary in different parts of the country. For example, the quality of the coal which is mined and the price which the coal can command in the market will determine, to some extent, its mineability. Mining methods and the technical problems of extracting the coal, with particular reference to cost factors, will also be a determinant, as will be accessibility to transportation facilities. These factors are not consistent, and thus it is not desirable to apply a common yardstick to the vastly separated coal areas of Canada with their varieties of coals and mining and marketing conditions.

In order to make the Commission estimate as practical as possible, different yardsticks have been applied in various areas across Canada. These mostly conform to mining practices in the various areas in respect to minimum thickness of seam and maximum depth of cover. Some variation is also made in regard to the yardstick applied to different ranks of coal. For Nova Scotia, the

estimate includes only coal of a minimum thickness of 3 feet with not more than 4,000 feet of cover except in the Joggins area where seams of average thickness of 2 feet are estimated. For New Brunswick, coal seams averaging 18 inches or more in thickness with not more than 500 feet of cover are included. The estimates for Ontario, Manitoba and Saskatchewan lignites include seams not less than 3 feet to a maximum depth of 500 feet. Alberta sub-bituminous coals are estimated on the basis of seams 3 feet or more in thickness with not more than 1,000 feet of cover. The estimates of Alberta and British Columbia bituminous coals include seams not less than 3 feet in thickness with a maximum depth of cover of 2,500 feet. The estimated reserves of British Columbia lignites and sub-bituminous coals and of the Yukon and Northwest Territories are on the basis of seams not less than 3 feet with a maximum depth of cover of 1,000 feet.

In most instances estimates of coal reserves relate to what might be termed "mineable" or "available" coal—that is, the estimate refers to coal which is considered to exist in mineable thicknesses within a required distance from the surface. However, it is unusual to recover even approximately 100 per cent of this coal. The degree of extraction varies greatly according to local conditions, both in respect to mining and market conditions. In any one operation recovery may be as high as 90 per cent, whereas in others it is as low as 20 per cent. In respect to larger areas, however, such as those included in the Commission estimate, the extent of recovery appears to be seldom more than 50 per cent. In the Commission estimate a distinction is made between "mineable" coal and "recoverable" coal, or coal which will likely be brought to the surface. The assumed extraction is 50 per cent.

Further terms are used, namely, "probable" reserves and "possible" reserves. Probable reserves include coal which by direct mining experience and by drilling, continuity to existing workings and areas drilled, or extensive geological data, can be reasonably expected to exist. Possible reserves are additional to probable reserves and include coal, the reasonable existence of which is based on limited geological data and prospecting and coal, the recovery of which is problematical due to its inferior quality and/or its relative inaccessibility. A specific gravity of coal of 1.29 has been taken as the conversion factor in calculating the reserves of the different provinces. On this basis, coal reserves are calculated at 80 pounds per cubic foot; 1,750 short tons per acre foot; or 1,120,000 short tons per square mile foot. Estimates of reserves are given throughout in short tons. The analyses are provided by the Division of Fuels of the Dominion Department of Mines and Resources and are on an "as received" basis.

Precise determinations of mineable and recoverable coal are possible only when relatively small areas are considered, when these have been extensively drilled and the deposits at least partially developed, and when local conditions are fully considered. Any overall survey of Canadian coal reserves must of necessity include coal reserves which have not been extensively drilled or developed, and must cover a diversity of mining and marketing conditions. In many instances, therefore, estimates cannot be more than mere approximations. Dr. MacKay has advised the Commission that the estimates are, in most instances, on the conservative side. The number of square miles used for purposes of calculation, with particular reference to the Provinces of Alberta and Saskatchewan, represent a very small percentage of the areas which are considered to be coal-bearing. This practice takes into full account the lack of continuity of the seams and the inconsistency of the coal formations and allows for extensive

erosion which is known to have taken place in certain areas. It is likely that greater knowledge of Canadian reserves will extend rather than contract the present estimates.

The table below provides in summary form the estimated coal reserves of Canada. Some 24 tables, giving particulars of the overall figures appearing below, appear in Appendix A.

Province	Mineable Coal			Recoverable Coal		
	Probable	Possible (additional)	Total	Probable	Possible (additional)	Total
	Thousands of net tons					
Nova Scotia	1,967,024	1,147,382	3,114,406	983,512	573,691	1,557,203
New Brunswick	89,814	11,566	101,380	44,907	5,783	50,690
Ontario	100,000	50,000	150,000	50,000	25,000	75,000
Manitoba	33,600	67,200	100,800	16,800	33,600	50,400
Saskatchewan	13,126,880	11,004,000	24,130,880	6,563,440	5,502,000	12,065,440
Alberta	34,437,630	13,436,560	47,874,300	17,218,870	6,718,280	23,937,150
British Columbia	11,795,480	7,034,556	18,830,036	5,897,740	3,517,278	9,415,018
Yukon	434,560	1,449,840	1,884,400	217,280	724,920	942,200
Northwest Territories	140,000	2,489,760	2,629,760	70,000	1,244,880	1,314,880
CANADA	62,000,000	37,000,000	99,000,000	31,000,000	18,000,000	49,000,000

It will be seen from the foregoing table that Canada is estimated to possess about 99,000 million tons of mineable coal or some 49,000 million tons of recoverable coal. Approximately 63 per cent of this tonnage is classified as probable. These figures are less than 10 per cent of the 1913 estimate. However, on the basis of the current level of production of coal in Canada, the reserves would be sufficient to allow for continued mining for over 2,700 years. It is apparent, therefore, that apart from local situations the chief interest in reserves lies in the location and characteristics of the deposits.

Alberta, according to the estimate, has some 48 per cent of Canada's reserves; with Saskatchewan possessing about 24 per cent; British Columbia, some 19 per cent; the Yukon and Northwest Territories, nearly 5 per cent; Nova Scotia, a little over 3 per cent; and the other three provinces having, in aggregate, about one-third of 1 per cent. Three western provinces, Saskatchewan, Alberta and British Columbia, have 92 per cent of the total reserves. Thus an estimate of Canadian reserves on the basis of mineable coal has the effect not only of drastically reducing the 1913 estimate but of changing the relative standing of the provinces. Alberta, in this present estimate, retains a leading position but is now credited with 48 per cent rather than 85 per cent of the total reserves. Saskatchewan replaces British Columbia as possessing the second largest reserves; and whereas Nova Scotia retains fourth place, its reserves form a greater percentage of the total.

Table 2 appearing in Appendix A gives a breakdown of the reserves shown in the above table according to the rank of the coals. From this table, it will be noted that approximately 15 per cent of the total reserves are of low volatile bituminous rank; some 31 per cent are of medium volatile rank; some 17 per cent, of high volatile bituminous rank; some 9 per cent, of sub-bituminous rank; and about 28 per cent, of lignitic rank. The low volatile bituminous coals are largely concentrated in the Inner Foothills belt of Alberta and the Peace River fields of northeastern British Columbia. The medium volatile coals occur largely in the Inner Foothills belt of Alberta and in the coal fields of southeastern and north central British Columbia. The high volatile bituminous coals are much more widely distributed, occurring both in the Maritime Provinces and in British Columbia, on Vancouver Island and in the south central area. A large percentage of the tonnage, however, is concentrated in the Outer Foothills belt

of Alberta. The sub-bituminous coals are largely confined to the Plains regions of Alberta. The lignite coals are widely distributed, occurring in Ontario and all the western provinces, but the principal mineable reserves are found in Saskatchewan.

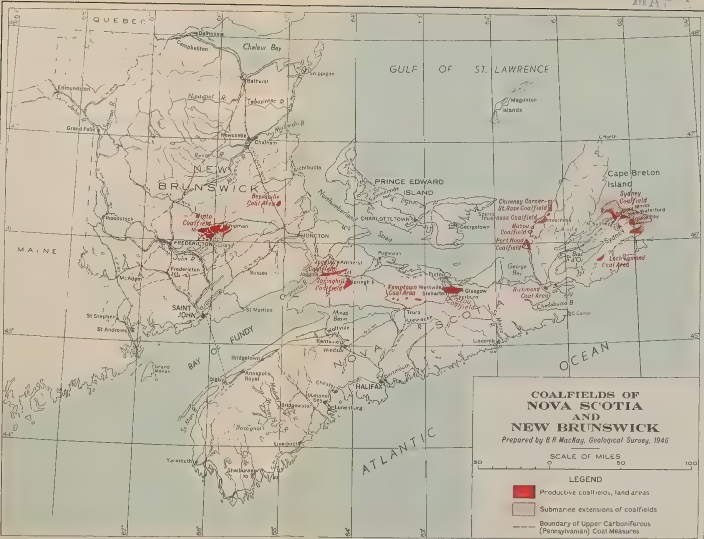
This breakdown of coal reserves by rank does not indicate the reserves of coking coals. This aspect of reserves is reviewed in later discussion of the coke and gas industry appearing in the chapter on Products and By-Products.

PROVINCE OF NOVA SCOTIA

The location of the 10 coal fields of Nova Scotia is indicated on Map 3 which shows the coal fields of Nova Scotia and New Brunswick. These coal fields may be conveniently grouped as those occurring on Cape Breton Island and those on the mainland. On the east coast of the Island there occurs the Sydney coal field, the most important field in the Maritimes. Several relatively small deposits occur on the west coast at St. Rose-Chimney Corner, Inverness, Mabou and Port Hood. In the south are two very small deposits in Richmond County and at Loch Lomond. On the mainland, the most important deposits occur in Pictou County in the Stellarton-Westville area, and Cumberland County in the Springhill-Joggins area. A small deposit occurs in Colchester County near Kemptown. All the coals of Nova Scotia are bituminous coals. The greater part of the coal produced classifies as high volatile "A" bituminous coal. Some medium volatile coal is produced in the Pictou field and a small amount of high volatile "C" is mined on the west coast of Cape Breton Island. The small deposit in Colchester County classifies as low volatile bituminous coal. The ash content of the Nova Scotia coals varies considerably, but generally it is not excessive in relation to competing bituminous coals in the markets served by Nova Scotia mines. The sulphur content of the coals, however, tends to be relatively high. They are generally good coking coals but this high sulphur content is a handicap in their use for the manufacture of metallurgical coke and of gas. An important feature in regard to the quality of Nova Scotia coals in relation to competing coals is their relatively low fusion point of ash. The range is from 2,025 to 2,490 degrees Fahrenheit.

The coal deposits of the Maritimes all are found in Pennsylvanian strata which extends over large areas there. The coal-bearing horizons are, however, much less extensive and are confined to the upper part of these Carboniferous rocks. Recent geological studies have shown that the coal deposits belong to three age series, the Riversdale, Cumberland and Pictou series, the classifications being made on fossil-plant evidence. There were long intervals in which barren, sandstone and shale were deposited with only relatively short intervals favourable to the growth of coal-forming vegetation. The St. Rose-Chimney Corner, Port Hood and Richmond coal deposits belong to the Riversdale series, the oldest of the series. The Springhill-Joggins deposits belong to the Cumberland or second oldest series. All the other fields belong, together with the New Brunswick deposit at Minto, to the Pictou series. With the exception of the Sydney field, the deposits in Nova Scotia are of small dimensions and, with the exception of the Pictou deposit, were formed from vegetation which grew on the location, the seams being characterized by uniformity of quality and thickness and a clay root-bearing floor. The Pictou deposit appears to have been formed from drifted vegetation, the seams showing wide variations in thickness and quality within short lateral distances and lack the typical clay root-bearing floor.

The readily accessible coal in the land areas of Nova Scotia has been mined, the remaining reserves therefore offer little opportunity of recovery by stripping operations. An exception to this general statement is the outcropping of one or two seams in the Sydney coal field. The land areas contain only very limited deposits, the most important reserves lying in the submarine areas of the Sydney



COALFIELDS OF
NOVA SCOTIA
AND
NEW BRUNSWICK
Prepared by B R MacKay, Geological Survey, 1946
SCALE OF MILES
50
0
50
100
LEGEND
Productive coalfields, land areas
Submarine extensions of coalfields
Boundary of Upper Carboniferous (Pennsylvanian) Coal Measures
QUEBEC
Dalhousie
Campbellton
Chaleur Bay
Bathurst
Edmundston
Grand Falls
Newcastle
Chatham
Richibucto
NEW BRUNSWICK
Beersville Coal Area
Minto Coalfield
Chipman
Woodstock
FREDERICTON
MONCTON
MAINE
Sussex
McAdam
Fredericton Jct
SAINT JOHN
St Stephen
St Andrews
St Martins
GULF OF ST. LAWRENCE
Magdalen Islands
PRINCE EDWARD ISLAND
Summerside
CHARLOTTETOWN
Georgetown
Northumberland Strait
Pugwash
Amherst
Joggins
Joggins Coalfield
Springhill Coalfield
Chignecto B
Pictou
Kemptown Coal Area
Westville
Stellarton
Glasgow
Pictou Coalfield
Truro
Minas Basin
Wolfville
Kentville
Windsor
BAY OF FUNDY
Grand Manan
Bridgetown
Annapolis Royal
Digby
Chester
HALIFAX
Dartmouth
Mahone Bay
Bridgewater
Lunenburg
Liverpool
Yarmouth
Shelburne
NOVA SCOTIA
ATLANTIC OCEAN
Cape Breton Island
Chimney Corner-St.Rose Coalfield
Inverness Coalfield
Inverness
Mabou Coalfield
Port Hood Coalfield
Sydney Coalfield
Sydney
Glace Bay
Loch Lomond Coal Area
Richmond Coal Area
George Bay
Chedabucto B
C Canso
C North
Liscomb

coal field. In view of the extensive knowledge of the geology of Nova Scotia, the Commission is advised that there is little likelihood of discovery of further coal deposits, with the exception of the possible field near Newville at Halfway Lake (16 miles southwest of Springhill).

In succeeding pages a brief description of the various coal fields is given, together with an estimate as to the reserve tonnage available for mining.

CAPE BRETON COAL FIELDS

Sydney Coal Field

As previously noted, the Sydney coal field on the eastern part of the Island is the most important field in the Maritimes. It yields about 80 per cent of the total output of coal in Nova Scotia and over 30 per cent of the total Canadian production, and although the field has been extensively mined during the past 120 years its remaining reserves are very considerable. Some particulars of the field appear on Map 4.

The chief centres of population in the area are Sydney, Glace Bay, Sydney Mines and New Waterford, communication with the mainland being maintained by the Canadian National Railways. One important feature of the geographical position of the field is its location on the Gulf of the St. Lawrence with good harbour facilities at Sydney and Louisburg. This is a very considerable asset to the coal industry in the Sydney field, as it provides for cheap water transport to the St. Lawrence Valley and Montreal in particular, to Newfoundland and to points on the Atlantic Coast (notably Halifax and Saint John).

The coal field extends northwesterly from Cape Morien in the east to Cape Dauphin, a distance of about 36 miles. It penetrates inland from the shore to a maximum distance of 8 miles and covers a land area of about 200 square miles. Much of the most readily available and best quality coal of the land areas has been mined. The coal field is terminated by faults on the northwest and southeast, known respectively as the Mountain Fault and the Bateston Fault. The extent of the seaward area between these faults is unknown, but sufficient is known from underground workings at some 3½ miles from shore to indicate the deposit persists beyond the limits of practical mining operations, insofar as the upper seams are concerned.

The productive coal seams occur in the upper third of the Pictou series (known locally as the Morien series). The Pictou series have a maximum thickness of 6,450 feet in the area but vary widely in thickness in different locations. They consist of grey and red sandstones and shale, some arkosic grits, conglomerate beds and a few limestone and shell fossil bands. The upper third of the series is chiefly shales and clays, the productive measures being made up approximately of 2 per cent coal, 60 per cent shale, 15 per cent fire clay and 23 per cent sandstone. There is a gradual gradation from coarse-grained sediments in the western area to fine-grained sediments in the eastern portion of the field. Generally the roof of the coal seams is a weak shale with local occurrences of sandstone. The floor varies from a soft fire clay to a hard shale.

In contrast with other coal fields in the Province of Nova Scotia, the Sydney coal field has suffered little disturbance. Folds are gentle and faults rare. Structurally it is characterized by gentle open folds having four northeasterly plunging synclines, designated the Morien, Glace Bay, Sydney Harbour and Boularderie synclines, separated by intervening northeasterly plunging anticlines

known as the Cape Percé, Bridgeport and Boisdale anticlines. The plunge of these structures closely conforms to the true dip of the measures, which is six to seven degrees in a northeasterly direction. The field includes 12 coal seams of commercial importance, ranging in thickness from 3 to 7 feet, 11 of which have been mined. Coastal erosion has attacked the anticlinal folds—thus dividing the coal field into individual basins. In many instances different names have been given to the same seam when worked in different localities. A correlation of the seams was made by the Geological Survey (Robb and Fletcher 1873) and still holds, although some uncertainty still exists as to the correlation of the seams on the north side of Sydney Harbour where some of the seams split and others appear to fail.

All of the coals mined in the field are high volatile "A" bituminous coals broadly conforming to the general description of Nova Scotia coals previously given. However, there is a considerable variation in the quality of the coal recovered from the various seams and between the coals of the various areas. A typical analysis of coal mined in the Sydney area is as follows:

	(As received basis)	
Moisture	Per cent	4.0
Ash	Per cent	8.4
Volatile Matter	Per cent	32.2
Fixed Carbon	Per cent	55.4
Sulphur	Per cent	2.9
Calorific Value	B.t.u./lb.	13,340
F.P.A.	°F	2,025

The Dominion Steel & Coal Corporation Limited submitted the following data to the Commission regarding recoverable coal reserves on leaseholds held by subsidiary companies in the Sydney field.

Name of Company	Estimated Recoverable Coal—Long Tons		
	Developed Reserves*	Other Coal Resources*	Total
Dominion Coal Co. Ltd.	402,800,000	389,966,000	792,766,000
Cumberland Rly. & Coal Co.	....	13,000,000	13,000,000
N.S. Steel & Coal Co.	42,250,000	163,450,000	205,700,000
	445,050,000	566,416,000	1,011,466,000

* The term 'developed' reserves is used in contradistinction to reserves of more doubtful value. 'Other Coal Resources' covers seams which, in the opinion of the Company, may be of less value than those now being worked or which by reason of physical conditions cannot be profitably mined at the present time. Also included in this category are seams which cannot be now proven on account of inaccessibility and where the evidence indicates a progressive deterioration in quality. Estimates of recoverable coal are based on:

(a) Presence of coal seam in workable height and quality.
(b) Underground development to a maximum distance of 5 miles from mine opening.
(c) Maximum depth of cover of 4,000 feet.
(d) Percentage of recovery in actual current mining operation.

On the basis of this estimate and an annual production of 5,500,000 tons, the company foresees some 80 years of operations on developed reserves alone, a further 100 years of operations being suggested in the estimate of other coal resources. The following table is an estimate of the life of the various collieries operated by Dosco subsidiary coal companies in the Sydney coal field as submitted by the company.

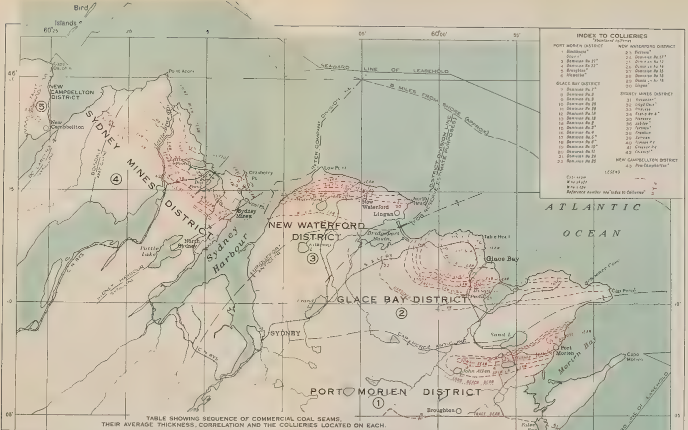


TABLE SHOWING SEQUENCE OF COMMERCIAL COAL SEAMS, THEIR AVERAGE THICKNESS, CORRELATION AND THE COLLIERIES LOCATED ON EACH.

Seam Sequence and General Name	PORT MORIEN DISTRICT Seam	Average Thickness	Colliery	GLACE BAY DISTRICT Seam	Average Thickness	Colliery	NEW WATERFORD DISTRICT Seam	Average Thickness	Colliery	SYDNEY MINES DISTRICT Seam	Average Thickness	Colliery	NEW CAMPBELLTON DISTRICT Seam	Average Thickness	Colliery
1 Point Aconi										Point Aconi	3.6				
2 Lloyd Cove										Lloyd Cove	5	Lloyd Cove Alexander			
3 Hub				Hub	9	Dominion No 7	Barachois	5.5		Stubbart	6				
4 Harbour	Blockhouse	6'	Blockhouse	Harbour	6	Dominion Nos 8 9 20	Victoria	5	Dominion Nos 12 14 17 Victoria	Sydney Main	5	Scotia No 4, Florence Princess, Jubilee			
5 Boutillier				Boutillier	3'		Fairyhouse	3'		Edwards	5'	Franklin			
6 Backpit	Tracy(?)	5		Backpit	4		North Head	4		Indian Cove	3	Tompson Pit Greener Pit Sullivan			
7 Phalen	Gowrie	6'	Dominion Nos 21 22 Gowrie	Phalen	7	Dominion Nos 1A 1B 2 3,4,5 6	Lingan	6	Dominion Nos 15 16 18 Lingan	Lonnie(?)	5	Colonial (Toronto)	Four Feet	4	
8 Stony										Stony	3'		Six Feet	6'	New Campbellton
9 Emery	Spencer	4		Emery	4	Dominion Nos 10 [illegible] 24									
10 Gardiner	Long Beach	2.5		Gardiner	4	Dominion No. 25									
11 Mullins							Mullins	4							
12 Tracy	Tracy	4	Hiawatha Broughton												

MAP 4

SYDNEY COALFIELD CAPE BRETON ISLAND NOVA SCOTIA

Prepared by B R MacKay, Geological Survey, 1946

SCALE OF MILES

2 0 2 4

To accompany Report by the Royal Commission on Coal 1946

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ESTIMATED RESERVES BY COLLIERIES OF DOMINION COAL COMPANY LIMITED AND OLD SYDNEY COLLIERIES IN THE SYDNEY COALFIELD AS SUBMITTED BY THE DOMINION STEEL & COAL CORPORATION LIMITED

DOMINION COAL COMPANY LIMITED, CAPE BRETON MINES

Colliery	Seam			Recoverable Coal (Long Tons)		
	Name	Height		Seam	Colliery Total	Estimated Life of Colliery
		Ft.	In.			Years
No. 1B	Phalen	7	0	47,000,000		
	Harbour	6	0	53,000,000		
	Hub	4	6	33,000,000	133,000,000	165
No. 2	Phalen	7	0	1,000,000	1,000,000	6
No. 4	Phalen	6	0	37,500,000	37,500,000	94
No. 11	Emery	3	0	600,000	600,000	4
No. 12	Harbour	5	0	30,000 000	30,000,000	60
No. 16	Phalen	5	0	15,500,000	15,500,000	30
No. 18	Phalen	5	0	1,000,000		
	Harbour	5	0	6,500,000	7,500,000	31
No. 20	Harbour	6	0	50,000,000		
	Hub	4	6	30,000,000	80,000,000	109
No. 24	Emery	3	0	4,300,000	4,300,000	16
Reserve for New Colliery	Phalen	6	0	50,800,000		
	Harbour	6	0	42,600,000	93,400,000	154
Total				402,800,000	402,800,000	90
No. 25	Gardiner (Inferior Grade)			3,500,000	3,500,000	25

NOVA SCOTIA STEEL & COAL COMPANY, OLD SYDNEY COLLIERIES

Princess	Harbour	5	0	33,750,000	33,750,000	84
Florence	Harbour	4	0	8,500,000	8,500,000	34
Total				42,250,000	42,250,000	52

The provincial Department of Mines' estimate covering the whole field placed the reserves at 2,345,100,000 short tons, 976,800,000 tons of which are considered as available for immediate production. A further 457,300,000 tons are thought to be reasonably certain whereas the remaining 911,000,000 tons include coal which is assumed to exist on less extensive geological data or is of inferior quality. The estimate is based on seams not less than 2 feet in thickness at a vertical depth of not more than 4,000 feet.

The estimate prepared for the Commission appearing as Table 4, Appendix A, is based on a careful examination of the work sheets of the foregoing company and provincial computations as well as the information available from the records of the Federal Geological Survey. Twelve maps of the Sydney coal field were prepared covering each of the commercial seams. The Commission estimate includes only coal of a minimum thickness of 3 feet to a maximum depth of 4,000 feet. A further limitation was applied to submarine areas, namely, a 5-mile limit from the shore. In some instances, coal has been classed as possible rather than probable due to the inferior quality of the coal rather than lack of evidence of its existence, and in one instance (regarding the Hub seam), the presumed deterioration of the coal added to the general lack of information as to the continuity of the seam has led to the omission of figures for a large area which might otherwise have been included as possible coal. It will be realized that these limitations are quite arbitrary, notably in respect to the submarine extension allowed in the estimate. The Commission is acutely aware of the difficult engineering problems, the heavy loss of time consumed by transferring

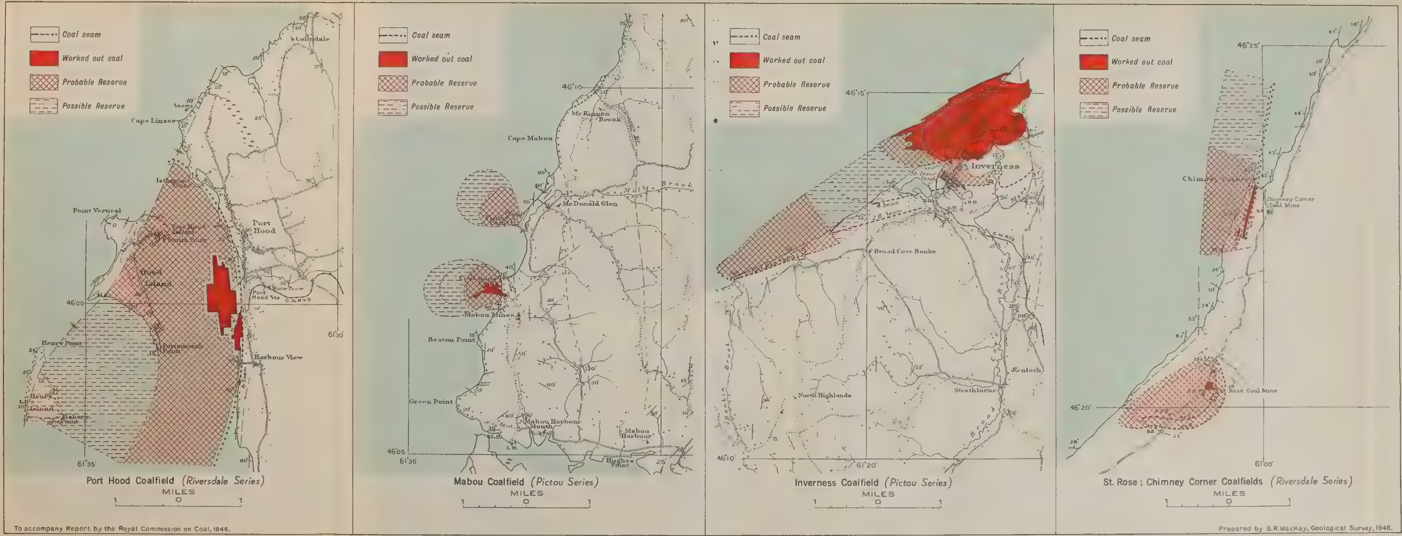
workers from the mine entry to the face and other high cost factors involved in submarine mining to such distances. At the same time technical advances in rapid underground transport, the development of cross-measure haulage tunnels and improved power transmission may increasingly allow such operations, and it is noted that the distance at which coal is now being recovered from under the sea is far greater than the pioneers of submarine coal mining had originally visioned as feasible. We are advised that seams below the Phalen seam will probably reach the limit of mineability either by thinning or by depth of cover before reaching the 5-mile limit. It is thought that non-persistence or deterioration in quality will limit mining operations in the Phalen seam and seams above it on the western and eastern parts of the field, whereas some of the upper seams will persist in commercial thickness and quality beyond the arbitrary 5-mile limit. Relatively little is known of the behaviour and quality of some of the upper seams, notably the Point Aconi seam, which outcrops very largely at sea, and the characteristics of submarine extensions of other seams are only a matter of deduction from meagre information. Apart from the outcropping of the Point Aconi seam in the Point Aconi area where stripping operations of a local nature may be possible, the efficient recovery of coal will generally involve large scale operations and their submarine extension. The Commission estimate gives overall figures of 1,764,184,000 short tons of probable mineable coal and a further 915,152,000 tons of possible coal. These figures are divided in half for an estimate of recoverable coal.

As might be expected there are considerable differences in these three estimates and these are partly explicable in terms of the different bases on which they are compiled. However there is general agreement that there are extensive coal reserves in the Sydney coal field. By common consent the life of the field will not be determined by the failure of the coal deposit, but will depend on ability to recover the coal at reasonable costs.

West Coast Coal Fields

As will be seen from Map 5, there are four coal basins on the west coast of Cape Breton extending from Port Hood northeasterly to Chimney Corner, a distance of some thirty-five miles. In order of occurrence and proceeding northward they are the Port Hood, Mabou, Inverness and St. Rose-Chimney Corner basins. The Canadian National Railways link three of the areas with the Mainland but the St. Rose-Chimney Corner area does not have railway service.

It will be recalled that the geological age of the deposits varies, the St. Rose-Chimney Corner deposit in the north and the Port Hood deposit in the south being of Riversdale age, and the Central Inverness and Mabou basins belonging to the younger Pictou series. It is possible that these two latter fields were once part of a continuous field now submerged beneath the Gulf of St. Lawrence but they are now structurally separated units. Mining operations have been carried out at various times in all of these locations and the land areas are now largely depleted with the exception of the St. Rose section of the St. Rose-Chimney Corner basin and a section of the Inverness basin. Characteristically the seams dip steeply at their outcrops, usually to sea, the angle of dip ranging from 45 degrees to 30 degrees, later flattening to an angle of 10 to 15 degrees at 2,000 feet from the outcrop. The West Coast coals are of lower rank and grade than coals of the Sydney coal field, and classify as high volatile "C" bituminous coals. Their ash and sulphur contents are higher than the Sydney coals, and they have a tendency to spontaneous combustion when stored in large quantities. The West Coast coals, however, have free-burning characteristics and are, therefore, more suitable than Sydney Coals for domestic consumption in hand-fired equipment. The quality of the coal seams on the West Coast, their inclination and almost entirely submarine position, restrict their immediate economic importance. It is apparent that mining in these fields will be largely confined to production for the local domestic market until such time as the reserves of the Sydney coal field are depleted.



MAP 5–Coalfields of Inverness County, West Coast Cape Breton Island. *(see Map No. 3 for index to positions)*

Reference to the Commission estimate of mineable coal in these fields (see Table 5, Appendix A) shows that the most substantial reserve tonnage of the West Coast coal fields is thought to be in the Port Hood area. This area extends southward along the coast from Isthmus Point for a distance of about 5 miles. The structure of the field is a southwesterly-plunging syncline, the axis of which extends from Cape Linzee southwesterly through Hood Island and across Henry Island. The eastern part of the basin has a dip of 20 degrees along the coastline lessening to 15 degrees some 2,000 feet from the outcrop and becoming horizontal at the synclinal axis. A "Six-Foot" or "Main" seam is the only mineable seam. It averages about 5 feet in thickness and has a strong shale roof. The ash content of the coal seam ranges from 6 to 18 per cent and the sulphur content up to 8.5 per cent. Calorific values range from 9,900 to 12,000 B.t.u./lb. In 1911 the Port Hood Mine which worked the seam was flooded from the sea and workings outside the flooded area have been intermittent since that time. The mineable reserve in the area lies under the sea to the south of the worked-out areas. The provincial authorities consider there are some 10,000,000 net tons of potential and possible reserves in the area.

The Mabou field is more disturbed geologically than any of the others on the West Coast of Cape Breton. The seams outcrop at four localities along a four-mile stretch of coastline, at Mabou Mines, Coal-Mine Point, Finlay Point and McKinnon Brook. They dip steeply seaward and their extension cannot be forecast definitely. Two seams, 7 and 8 feet in thickness, have been mined intermittently, operations on the 7-foot seam being terminated in 1909 by flooding through the sea floor. The ash and sulphur contents of the coal range from approximately 5 to 25 per cent ash and up to 6 per cent sulphur. Calorific values range as high as 13,650, with an average value of 10,900 B.t.u./lb. The Commission estimate of reserves is limited to two small areas at Coal-Mine Point and Finlay Point. The Province gave the field a reserve of 5,000,000 potential and 27,000,000 possible tons.

The Inverness area, which extends from the mouth of the Broad Cove river southeasterly along the coast for some 6 miles, contains very limited mineable reserves. Four commercial seams outcrop in the area, all of which dip seaward at angles of 15 to 30 degrees, the angle of dip in places increasing to 60 degrees. Three of these seams, the 13-foot, 7-foot and 4-foot seams have been worked and mining has advanced beyond the point of commercial operation, the Provincial Government having operated in the field since 1933 in order to give relief to the community. The ash content of the coals ranges from 6 to 25 per cent, the sulphur content up to 10 per cent, and calorific values as high as 12,400 with an average of 11,000 B.t.u./lb. Very small tonnages are available from the Port Ban Seam, which constitutes the principal reserve in the field.

The St. Rose-Chimney Corner basin is divided into two sections, the Chimney Corner field in the north and St. Rose field to the south. The two fields contain the same coal seams but are separated by an interval of faulted strata of approximately 2 miles in which no coal is known to occur. The St. Rose deposit is confined to a land basin measuring 2 miles by 1 mile where two seams of 6 and 7 feet in thickness outcrop, the former being worked by a small mine. The ash and sulphur contents of the coal average 11.8 and 7 per cent respectively and the calorific value is 11,660 B.t.u./lb. The provincial estimate gives the area a total of 8,850,000 tons of potential reserves. The Chimney Corner reserves lie largely under the sea, the two commercial seams of the area dipping steeply at the outcrop but flattening to about 18 degrees. Mining operations in the area have been very restricted. The ash content of the coal averages 8 per cent, sulphur content 4 per cent and calorific value 11,000 B.t.u./lb.

Richmond-Loch Lomond Areas

Comparatively little is known about these two coal areas. In the River Inhabitants basin of Richmond County, coal outcrops have been discovered at various points. One seam with numerous included dirt bands is 11 feet thick. The coal is high in ash and sulphur, and the measures are considerably deformed. It is, therefore, unlikely that the field will ever be of more than local significance. Some small tonnage has been mined for local usage and the Province suggests that there are remaining reserves amounting to 5,000,000 tons of potential and 5,000,000 of possible coal.

The Loch Lomond basin which lies to the northeast may be an outlying remnant of the Sydney coal field but has never been drilled to establish this or the extent of the deposit. One seam on the northern outcrop of the basin has been worked to a very limited extent and the area is believed to contain reserves which will have local significance. The coal is reputed to have a low sulphur and ash content and to be suitable for metallurgical purposes. No estimate of the reserve was given by the Province. The Commission estimate for these two areas appears in Table 5, Appendix A.

THE MAINLAND COAL FIELDS

Pictou Coal Field

The Pictou coal field, which is one of the remaining important coal fields in Nova Scotia, has its centre at Stellarton 2 miles south of New Glasgow. The field extends about 6 miles to the east beyond Thorburn, and westward to about 3 miles beyond Westville, and is about 3 miles across in its north-south axis. The area is served by the main line of the Canadian National Railway from Truro to Sydney, and from Stellarton a branch line runs to Pictou Landing from whence the trans-shipment by water can be effected to points on the St. Lawrence. New Glasgow is the community centre, the mining towns being Stellarton, Westville and Thorburn.

The coal field is bounded by faults of large displacement, and consists of three separate mining areas, which from west to east are the Stellarton, Westville, and Thorburn areas. Faults separate these from one another, but the displacement between the Thorburn and Stellarton coal areas is not so pronounced as that which separates the Stellarton and Westville areas. The coal measures in the Stellarton area, and to a lesser extent those in the Westville area, have been further cut by cross-faults, with the result that the coal seams have been sufficiently displaced as to seriously handicap mining operations. The coal seams of each of these areas belong to the Pictou series (known locally as the Stellarton series) but occur in three different geological formations of the series. Those occurring at Westville are the older and belong to the Westville formation; those at Stellarton belong to an intermediate formation known as the Albion formation; and those at Thorburn belong to the youngest formation in the field designated the Thorburn formation.

In the Westville area there are at least 4 seams, 2 of these, the Acadia and Scott seams, having thicknesses of 17 and 12 feet, constitute the main reserve of the area. The two lower seams, each having an average thickness of 6 feet, are of inferior quality and have remained largely unprospected. Their behaviour is therefore relatively unknown.

In the Stellarton area there are at least 10 seams, 5 of which have been mined. They have thicknesses ranging from 8 to 40 feet and have been the main source of production in the Pictou field. The other 5 are known only from a few drill holes put down from the mine workings in the Acadia No. 1 seam, the lowest seam so far worked in the Stellarton area, but are not believed to be of commercial importance.

In the Thorburn area there are 5 seams, 4 of which are over 3 feet in thickness. All of these have been extensively mined, but substantial reserves remain in the lower two seams, namely, the Six-Foot and McBean seams.

The Thorburn area is well defined, being a separate shallow structural basin in which the coal seams outcrop on the eastern and western rims, but are cut off by faults on the south and north. This is in marked contrast to the Stellarton and Westville areas where the coal seams dip from their outcrops northward at angles of from 20 to 25 degrees for a distance of almost a mile before being cut off by faults of large displacement.

One feature of the Pictou coal field is that the deposits of the Westfield and Stellarton areas, and to some extent those of the Thorburn area, give evidence of having been formed from an accumulation of drifted vegetation. In this, the deposits differ from those of the other coal areas of the Maritimes. The mode of origin of these deposits has affected the quality of the coal and has a direct bearing on mining practices in the field. The fact that the coal-making material was washed or rafted into place has given rise to great variation within short distances in the thicknesses of the coal deposits and the intervening sediments. This is shown to a marked degree in the case of the Foord seam at Stellarton, which ranges up to 40 feet in thickness. The Foord seam and the underlying Cage seam near the outcrop are separated by a stratigraphical interval of 150 feet, whereas at the bottom of the basin, 3600 feet below the outcrop, the seams are only 10 feet apart. The mode of deposition has given rise also to wide variations in the quality of the coal. In particular the admixture of silt and finely-divided mineral matter with the rafted vegetation has resulted in the coal having a relatively high ash content, the ash being dispersed throughout the coal, with the result that its removal by hand picking and simple preparation is difficult. Again deposition of the vegetal matter under moving currents of water tended to separate the finer divided vegetal matter such as spores and leaves, and to concentrate them in sections of the seam so as to form lenses and stringers of carbonaceous matter differing from the main body of the coal. The presence of such lenses tends to increase the possibility of spontaneous combustion, a factor which has been a definite hazard to mining operations in the Pictou field, particularly in the Stellarton workings.

The Pictou coal field in relation to its size is the most extensively exploited coal field in Canada, some 75 million tons having been mined in the area over a period of about 125 years. As a result of this extensive mining, most of the readily accessible coal has been recovered, and the field has now arrived at what might be termed its final stage of commercial operation. The remaining large reserves in the area are found in the McBean and Six-Foot seams of the Thorburn area, the Foord seam of the Stellarton area and the Acadia (or Main) and Scott seams of the Westville area, the latter seam being of somewhat inferior quality.

The Acadia Coal Company, the principal operator in the field, estimates on the basis of its own leases and the current level of production, a future life for the field of between 40 and 50 years, the figures being as follows:

	Long tons
Developed Reserves	13,540,000
Other Coal Resources	14,400,000
Total	27,940,000

The Provincial Government's estimate suggested more extensive reserves may be available in the field, notably in the instance of the Stellarton area.

Dr. MacKay's estimate (see Table 6, Appendix A) substantially agrees with the Company's estimate, but also indicates, in line with the Provincial estimate, that the reserves may prove more substantial than presently anticipated, in which case operations, probably of a more limited nature than those of today, may continue beyond the period suggested by the Acadia Coal Company.

Coal Fields of Cumberland County

There are two separate coal areas in Cumberland County which lies to the west of Pictou County. These are the Springhill and the Joggins coal fields. The two areas are separated by a broad southwesterly-plunging syncline consisting of barren rock. The workable seams in both areas are of the same broad geological age, being confined to the Cumberland series of the Upper Carboniferous (Pennsylvania) rocks. The seams in the Joggins area lie in the lower part of the series, whereas those of the Springhill area are younger, and are found in the upper portion of the series. The main reserves in the county are found in the Springhill area.

The centre of the Springhill coal field is at Springhill which is some 5 miles southeast of Springhill Junction on the Canadian National Railways. The coal seams outcrop over a distance of about 6 miles, but the productive measures are confined to about 2 miles, the seams on either side becoming progressively invaded by bands of stone rendering them unmineable. The Cumberland Railway and Coal Company, the sole operator in the field, owns and operates a railway which runs from Springhill Junction on the main line of the Canadian National Railways through Springhill to Parrsboro, a distance of 32 miles. Parrsboro is located on the shore of Minas Basin to the southwest of Springhill, and is the site of a shipping pier from which coal can be shipped to ports on the Bay of Fundy.

The seams lie on the northwestern flank of a southwesterly-plunging anticline and dip at the outcrop at angles as high as 60 degrees, the average being 32 degrees. The angle of inclination gradually flattens with depth. The No. 2 seam, which has been mined to a depth of 3,821 feet, or a distance of 11,400 feet from the outcrop, has at the lowest workings a dip of 12 degrees. Six seams occur in the formation ranging in average thickness from 4.5 to 10 feet. All of these seams have been mined for distances ranging from 1,000 feet to a maximum distance of over 11,000 feet. These six seams are contained within about 1,200 feet of measures being separated from one another by intervening strata of interbedded sandstones and shales ranging in thickness from 70 to 700 feet. The presence of strong sandstone strata above or below the coal seams provides ideal conditions for mining, and has allowed the extraction of the full thickness of 9 feet of coal from No. 2 seam at a depth of over 3,800 feet. On the other hand the nature of the measures presents a serious handicap to deep mining operations. At depth, the extraction of coal results in transference of the load of the overlying strata to the coal seam in advance of the workings, but this transference is delayed by the existence of the strong sandstone bands abovementioned, causing accumulation of the stresses in the sandstone to a point where the band fractures suddenly, and transmits the whole accumulated stress suddenly, without warning or previous signs of distress, to the weaker coal seam, which explodes, or "bumps," hence the local name for these outbursts. Whereas these conditions may not prevent further mining of the seam, the occurrence of "bumps" has led to the abandonment of a number of sections of the field in favour of areas where more flexible surrounding rocks permit the safe extraction of the coal.

The coal in the Springhill area classifies as high volatile "A" bituminous coal, and is a good coking coal. A typical analysis is as follows:

	(As received basis)	
Moisture	Per cent	2.8
Ash	Per cent	9.7
Volatile Matter	Per cent	29.9
Fixed Carbon	Per cent	57.6
Sulphur	Per cent	1.6
Calorific Value	B.t.u./lb.	13,225
F.P.A.	°F	2,255

Coal has been extracted from the Springhill coal field for the past 75 years, and like the Pictou coal field, the more readily accessible coal has been mined. It is extremely difficult to arrive at any forecast of the reserves of the coal field because of two factors, the nature of the deposit and the structural deformations that have taken place since its deposition. The evidence suggests that the deposits were laid down in a valley between mountains and thus were confined to a limited area. Moreover the vegetation on the fringes of this narrow basin was contaminated by a constant influx of sands and silts carried into the valley from the surrounding areas by streams. As a result the coal seams in the marginal areas are characterized by an interbedding of coal and rock. Thus, although some of the coal seams have been traced for a distance of 6 miles along the outcrop, the productive field has been found to be limited to a distance of about 2 miles, the quality of the seams deteriorating seriously beyond this limit. On the other hand, the folding and faulting to which the coal measures in the southern part of the field have been subjected suggest that there are probably pockets of good quality coal outside of this 2-mile limit. These pockets would result from the pressure of the strata on the coal at the time of folding which had the effect of squeezing out the coal from the most tightly compressed parts of the fold and transferring it to the areas of easier compression. Dr. MacKay advised the Commission that our estimate of possible reserves includes some allowance for such occurrences.

The company's estimate of reserves which is given below is based on an intimate knowledge of the developed portion of the field, and on the basis of the current level of production the company considers that the life of the field is limited to 25 to 40 years:

	Long tons
Developed Reserves	17,500,000
Other Coal Resources	600,000
Total	18,100,000

The provincial estimate of reserves indicates agreement with the company figures in respect to assured reserves. It is apparent, however, from the large estimate of possible coal, amounting to 156,200,000 net tons, that the provincial authorities consider the field to have a much greater life-expectancy.

The Commission is advised that the company's estimate is conservative. As will be seen from Dr. MacKay's estimate (see Table 7, Appendix A) it is considered likely that the field will have a more extended life than the company figures suggest, but his figures are very considerably less than those of the province.

The Joggins coal field extends from Chignecto Bay eastward to beyond Styles Brook for a distance of about 19 miles. Some mining has been done under Chignecto Bay and the westward limit of the deposit has not been determined. The principal mining centre is Joggins, with smaller operations at River Hebert, Maccan and Chignecto. Maccan lies on the Canadian National Railways' main line, and spur lines owned by the Maritime Coal Railway and Power Company connect Joggins, River Hebert and Chignecto with the Canadian National Railway at Maccan. Mining operations have been carried on in the field for about 100 years, and all the most readily accessible coal has been extracted.

The coal seams of the Joggins field occur on the north limb of a broad southwesterly-plunging syncline, the axis of which lies about midway between this field and the Springhill field. The seams dip to the south at angles ranging from 18 to 25 degrees. In the Joggins area of the field there are 5 seams, all of which are now being mined. Only one of these has a maximum thickness of more than 3 feet. Traced eastward and in depth these seams thin progressively

and deteriorate in quality, and some of them peter out. At River Hebert only 4 seams are present, and 2 seams only outcrop at Maccan and Chignecto. All of these seams are being mined even though the seam is less than 20 inches thick. The field is cut by numerous cross-faults of sufficient displacement to hamper mining operations, and where they permit the infiltration of water they have led to the abandonment of collieries.

The coal in this field is classified as high volatile "A" bituminous coal but is of low grade because of high ash and sulphur contents. A typical analysis of the coal is as follows:

	(As received basis)	
Moisture	Per cent	4.5
Ash	Per cent	18.4
Volatile Matter	Per cent	32.2
Fixed Carbon	Per cent	44.9
Sulphur	Per cent	6.0
Calorific Value	B.t.u./lb.	10,900
F.P.A.	°F	2,060

The provincial estimate places the reserves of the Joggins field at 16,020,000 short tons of probable coal with an additional 142,000,000 tons of potential and possible coal.

The Commission estimate places the mineable reserves at about 47 million tons of probable coal with an additional 41 million tons of possible coal. Both estimates placed the principal reserves in the Maccan area. Whereas the Commission estimate of probable coal is higher than that of the province, the overall figures of our estimate are very much lower. These figures would seem to conform with the submission of the Nova Scotia Department of Mines that "Although reserves are limited, this field (Joggins) should be capable of restricted production for some time."

As previously noted, it is possible that a concealed coal field may be present near Springhill on the east side of Fullerton Lake about 13 miles southeast of Joggins. This possibility is based on a report that a borehole put down by the Standard Coal and Railway Company prior to 1904 penetrated nine feet of coal at a depth of 2,550 feet.

Colchester County

Outcrops of coal occur at several places in Colchester County, including Riversdale, Campbell Siding, Debert and Kemptown. These outcrops are believed to be reappearances of a single seam. The geological age of this deposit has not been determined, but it is thought to be of Riversdale age. The seam has been mined to a very limited extent near Kemptown, which lies near the Canadian National Railway line from Truro to Sydney, about 12 miles east of Truro. These operations have indicated that the deposit may be badly disturbed by folds and broken by faults. Where traced, the seam is thin, nowhere having an average thickness of more than 3 feet.

The coal is of relatively high rank, classifying as low volatile bituminous coal. It is, however, of low grade due to its high ash content, 28 tests of the coal in the Kemptown area showing an average ash content of 17 per cent. Its calorific value ranges from 10,750 to 14,450 B.t.u/lb. and averages 12,200 B.t.u./lb. The coal is thought to be amenable to washing.

It is suggested by the Provincial Government that this deposit may assume added value if further investigations of the coal prove it is suitable for mixing with the Sydney coals in the production of metallurgical coke. Very little, however, is known of the extent of the deposit and present information suggests that it has very limited significance. The provincial estimate of reserves is restricted to 1,000,000 tons of possible coal. According to Dr. MacKay's

estimate of 1,180,000 tons of probable recoverable coal, and 3,360,000 tons of possible recoverable coal, the field has greater possibilities than suggested by the provincial figures.

SUMMARY

Reference to Table 3, Appendix A, shows that, according to the Commission estimate, Nova Scotia reserves of mineable coal are approximately 1,967,000,000 tons of probable coal with an additional 1,147,000,000 tons of possible coal. Recoverable coal would be about 50 per cent of these figures. A very large proportion of these reserves is contained in the Sydney coal field and it is apparent that this field will be increasingly the centre of production of coal in the Province. We feel the remarks of the Provincial Deputy Minister of Mines summarize effectively the general reserve situation in Nova Scotia when he stated:

> "Although the remaining reserves are very much less than those formerly estimated, there is no immediate shortage of coal substance. The limits of production will be set not by lack of coal but by economic factors of mining costs, coal quality and ways of mining it."

PROVINCE OF NEW BRUNSWICK

As will be seen from Map 3, an extensive area of New Brunswick totalling more than 10,000 square miles is underlain by Upper Carboniferous rocks of Pennsylvanian age, being an extension of the coal-bearing formations of Nova Scotia of the same age. However, only a very limited section of the extensive coal-bearing areas of New Brunswick is known, as yet, to contain coal deposits which admit of commercial development. This section is the Minto coal field or Grand Lake coal-basin situated immediately north of Grand Lake.

About 50 miles northeast of this area, there is a further deposit, the extent and value of which cannot be readily determined on the information currently available. Mining operations along Coal Branch River have shown this deposit to extend from Coal Branch on the Canadian National Railway for a distance of about 10 miles northeast to Beersville. Very limited development work only has been carried on in the area, a few hundred tons being mined annually. The seam is known to be of the same horizon as that occurring in the main Minto field but is thinner in this area. Where mined, it has ranged from 13 to 18 inches with an average thickness of 15 inches. The coal seam appears to have a general dip to the northeast, the overburden ranging from 20 feet at Coal Branch to 100 feet at Beersville. Development work suggests that the seam is continuous throughout the area and maintains uniformity in thickness and quality. Due to the relatively thick overburden at Beersville, little, if any, prospecting has been done in the area to the northeast and it is impossible to determine how far the deposit continues in this direction. At the present time, only a small portion of the field has been taken up, an area of some 120 acres being held under lease, and 80 acres being held under mining licences. One mining claim of 40 acres is in effect.

No figures covering the coal reserves in the Beersville area are included in the Commission's estimate due to the relatively small amount of information available on the reserves and the very doubtful possibility of commercially mining a seam of this thinness and quality.

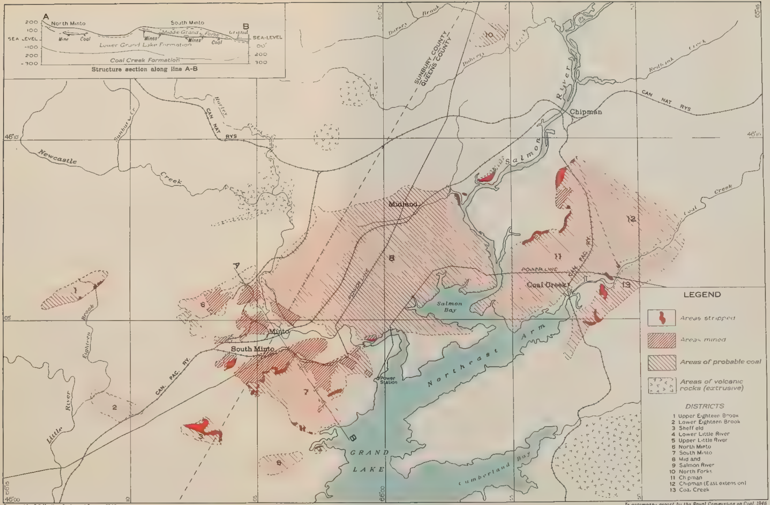
Outside of these two areas coal has been reported at 76 localities widely scattered through 12 counties in the Province. Some of these are known to consist of isolated occurrences. Most of them consist of coal seams less than one foot in thickness. On the present evidence it does not appear that they have any economic value, and the chances of discovering new coal fields of commercial importance in New Brunswick are considered remote.

The Minto Coal Field

As will be seen from Map 6, the Minto coal field is centrally located in southern New Brunswick at the northern end of Grand Lake. The centre of the field is about 33 miles northeast of Fredericton, 58 miles due west from Moncton, 55 miles due north of Saint John, and 65 miles southwest from Newcastle. Minto and Chipman are the chief centres of population. The region is gently undulating with a maximum relief of 500 feet. It is drained by the Salmon River, Newcastle Creek, Little River and Coal Creek which flow southerly into Grand Lake. The mines lie amid very poor farm lands and wood lots, with unbroken forests to the northwest. They are served by the Canadian National and the Canadian Pacific Railways, and by good roads. Barges may be moved through Grand Lake to Saint John and Fredericton via the St. John River.

Briefly described, the Minto coal field is a shallow structural basin of the Grand Lake formation covering an area about twenty miles in length and five to six in width. The longer axis of the basin extends from near the junction of Eighteen Brook and Little River northeasterly to cross Newcastle Creek about a mile north of Minto where it continues in a more easterly course about half a mile west of Salmon Bay eastward through to the valley of Coal Creek. As previously noted it is a remnant of the pre-glacial erosion which removed many thousands of feet of coal-bearing sediments from vast areas of the Province. The coal seam occurs in the central part of the Grand Lake formation which consists of massive and laminated sandstone separated by impervious shale. All the coal mined in the Minto field is from the main or surface seam. The seam varies in thickness from 16 to 30 inches, averaging about 18 inches, being thickest in the southwestern section of the field and thinning out in the northern and eastern parts of the fields, in some places being represented by only a few inches of carbonaceous material. Over large areas, the seam is fairly uniform in thickness and quality, the only very variable features of any importance being the presence of one or more partings and an occasional fault of small displacement. A number of very thin lower seams are present in places but apart from the Minto district where one or more 2- to 6-inch seams are commonly associated with the main seam and in some operations are mined with it, they are not of economic importance. The coal is usually underlain by 2 to 4 feet of root-bearing fire clay, and is overlain by 2 to 5 feet of laminated greenish-grey shale. Throughout most of the central portion of the basin, the seam is flat-lying or very gently undulating. On the north side of the basin it has a southeasterly dip which gradually increases from 50 feet to the mile, to a maximum of 150 feet to the mile on the northern rim. The southern rim of the basin has a dip to the northwest towards the centre of the basin but the dip is less pronounced seldom exceeding 100 feet to the mile. Over much of the area the overlying bedrock and a considerable part of the coal seam have been removed by pre-glacial erosion, the extent of which is difficult to determine due to the cover of subsequent glacial drift. As a result of the basin-like structure of the field and the pre-glacial erosion, glacial deposition and subsequent post-glacial erosion that have taken place, the coal seam is now found at varying depths, ranging from surface outcrops to a maximum of 170 feet. In about a third of the coal field the coal seam lies within 20 to 50 feet of the surface, whereas over the remaining two-thirds of the area it has a cover of from 50 to 170 feet. The seam ranges in elevation from below the summer level of Grand Lake which is 4 feet above sea level, to a maximum height of about 260 feet above sea level.

Coal mined in the Minto area is classified as high volatile "A" bituminous. In rank, it is comparable to the coals of Nova Scotia. In grade, however, it is inferior due to excessive impurities and its physical characteristics. It contains an appreciable quantity of visible pyrite and the ash and sulphur contents in run-of-mine coal range from 15 to 25 per cent and 5 to 9 per cent respectively.



Prepared by B. R. MacKay, Geological Survey, 1946
Based on G.S.C. maps and reports, and data supplied by the Department of Lands and Mines, New Brunswick.

To accompany report by the Royal Commission on Coal, 1946

MAP 6

MINTO COALFIELD
(GRAND LAKE COAL BASIN)
NEW BRUNSWICK

SCALE OF MILES
1 0 1 2 3 4 5

Calorific values range from 11,000 to 12,000 with an average of 11,600 B.t.u./lb. Analyses of coals produced by three of the principal collieries in the Minto field are as follows:

ANALYSIS OF MINE RUN SAMPLES (AS RECEIVED BASIS)

—	Minto Coal Co.	Percentage of Total N.B. Prod. 1944	Miramichi Lumber Co.	Percentage of Total N.B. Prod. 1944	Avon Coal Co. Ltd.	Percentage of Total N.B. Prod. 1944
Proximate Analysis........	....	33.53	....	11.70	....	13.75
Moisture.......Per cent	3.0		3.0		3.0	
Ash............Per cent	17.2		18.5		16.9	
Volatile Matter.......Per cent	30.2		29.7		30.2	
Fixed Carbon..Per cent	49.6		49.8		49.9	
Calorific Value...B.t.u./lb.	11,950		11,830		11,950	
Sulphur..........Per cent	7.2		6.6		7.7	
F.P.A........... °F.	2,040		2,200		2,030	

The coal is strongly coking but its high sulphur and ash content make it unsatisfactory for the production of commercial coke. The coal is highly fractured and breaks down readily on handling, mining and cleaning operations resulting normally in a run-of-mine coal of about 66 per cent of 1½ inch slack. This, in conjunction with the high sulphur content, makes the coal subject to spontaneous combustion when stock-piled.

As will be readily appreciated from the foregoing description, the fundamental geological factor in respect to the development of the Minto field is the extreme thinness of the coal seam and its inferior quality.

The secondary geological factors which bear upon the development of the field are:

(1) Pre-glacial erosion of the coal measures and the weathering of the exposed coal.
(2) Glacial erosion and deposition and post-glacial stream erosion.
(3) The inclination of the coal seam and its minor undulations.
(4) The porous nature of the sediments associated with the coal seam.
(5) The low level of the coal basin and general low relief of the area.

Pre-glacial erosion appears not only to have removed the Grand Lake coal-bearing formation from extensive areas in the province outside of the Minto basin, but has dissected the basin itself so that now in effect it consists of several deposits rather than one. The field thus consists of one relatively large central area with detached smaller areas on the east, south and west, separated from it by the main watercourses and barren areas from which the coal has been eroded. Where coal seams were exposed by pre-glacial erosion they were subjected to deterioration by weathering, and in places this erosion reduced the thickness of the seam to only a few inches.

Glacial activity resulted in a further removal of the weathered coal where the seams were exposed, and over most of the area has concealed the seams or bedrock by a thick blanket of drift, filling completely some of the pre-glacial valleys from which the coal has been removed, so that the boundaries of the productive areas can only be determined by development and extensive systematic drilling.

This problem has been accentuated by the post-glacial erosion of the existing watercourses which have excavated new channels through the coal-bearing formation, and have exposed the coal seam along their valleys. The presence of

these exposures is apt to suggest the existence of an extended coal deposit, whereas investigations have later shown that this coal had been removed by adjacent pre-glacial channels the existence of which was not suspected due to the blanket of glacial drift.

This blanket, which conceals the bedrock over much of the area, consists mainly of unconsolidated ground-up rock and clay largely impervious to water. Where it directly overlies the seam it has protected the coal from weathering. It seldom exceeds 30 feet in thickness and again where it immediately covers the coal it provides from the point of view of depth of cover and ease of its removal favourable conditions for open-cut mining. However the nature of the glacial drift also raises problems in respect to these operations. Unlike the bedrock, due to its unconsolidated character it readily slumps into the open-cuts, especially where the drift exceeds 25 feet in thickness. Again the impervious nature of the boulder clay tends to retain surface water in the excavations and to restrict the seepage of this water to the bedding plane of the coal seam, with the result that it not only retards operations on the site, but interferes with operations down the dip of the seam.

The last three geological factors listed above are of special significance in respect to drainage problems generally. The nature of the coal measures and the basin-like structure of the deposit permit the surface water which enters at the outcrop, or seeps down the joint planes of the overlying sediments, to percolate down the bedding planes of the coal seam. The entry of water at the outcrop is particularly important in areas where the coal deposit has been cut by water courses and extends beneath the level of Grand Lake.

The concentration of water becomes of increasing importance in regard to the development of the deposit down the dip of the seam and reaches serious proportion in the centre of the basin where the intake is from all directions. Disposal of water throughout most of the Minto coal basin is difficult owing to the low relief of the area generally. In respect to the centre of the basin where the accumulation is greatest, the problem is accentuated by the fact that the coal seam lies well below the level of Grand Lake and its several inlets.

According to the provincial Department of Mines, the Minto coal field in 1943 had reserves amounting to 69,474,900 tons of recoverable coal with a further possible reserve of 8,809,400 tons.

The estimate prepared for the Commission, details of which appear in Table 8, Appendix A, places the reserves of recoverable coal at 45,000,000 short tons with a possible additional 6,000,000 tons. The coal operators in the Minto field consider the reserves should be placed between 18 and 25 million tons of recoverable coal as extraction of the coal in some areas is problematical.

The Commission is advised that about one-third of the above reserves, or about 15 million tons, are available for recovery by stripping operations, but that underground operations will continue to be of primary importance in the field. The figures suggest that the reserves are sufficient to last for at least 75 years on the basis of maximum annual production to date.

PROVINCE OF ONTARIO

There are no deposits of coal of any immediate commercial significance in the Province of Ontario. The presence of a poor quality lignite in northern Ontario in the region south of James Bay has been known to Indians and Traders for a long time and these deposits have been examined periodically by the Geological Survey since 1871.

The most important of these deposits outcrops at Blacksmith Rapids on Abitibi River, 70 miles up-stream from James Bay. This deposit has its maximum development some 2 miles west of the outcrop near Onakawana River and for this reason has been called the Onakawana field.

Since 1929 intensive investigations have been made, principally by the Ontario provincial authorities, to determine the extent of this deposit, its mineability and possible beneficiation of the coal for commercial use. These investigations have shown that the deposit covers an area of about 6 square miles, the coal occurring as an open-basin deposit and lying beneath a cover of glacial drift ranging to 150 feet in depth and capped by swampland, bush and muskeg. The coal seam in this area ranges in thickness from 10 to 40 feet, averaging about 20 feet, and in the central part of the area, covering less than a half square mile, is overlain by an upper seam ranging up to 30 feet in thickness, separated from the lower deposit by a clay bed from 5 to 20 feet in thickness. The deposit is irregular due to intensive erosion. According to the Ontario Department of Mines the deposit contains about 100,000 000 tons.

Although classified under the A.S.T.M. classification as lignite, the very inferior quality of the coal is evidenced in the following typical analysis provided by the Federal Department of Mines.

		(As received basis)
Moisture	Per cent	50.0
Ash	Per cent	6.3
Volatile Matter	Per cent	21.3
Fixed Carbon	Per cent	22.4
Sulphur	Per cent	0.7
Calorific Value	B.t.u./lb.	5,090

Recent investigations have included the erection of a small plant designed to convert this inferior lignite into a marketable product for domestic, railway and industrial use. The results have been unsatisfactory, and in 1944 a Select Committee of the Ontario Legislature reported the development of the deposit at Onakawana to be commercially unsound. The Committee further advised that in view of the investment already made, certain experimental work should be continued, and it is noted that the Ontario Government is currently producing about 30,000 tons for local use in order to meet the anticipated fuel shortage in parts of Canada this winter.

PROVINCE OF MANITOBA

Very limited deposits of lignite of Tertiary age occur in southwestern Manitoba, about 150 miles southwest of Winnipeg. These deposits are believed to be an eastern extension of the lignite deposits of southern Saskatchewan, apparently having been isolated by erosion from the main deposit.

The deposits occur along the northern and western slopes of Turtle Mountain, but their full extent is not known. Determination of the boundaries of the coal measures and the continuity of the seams is difficult due to the thick blanket of glacial drift which mantles the area, and there has been little incentive to initiate the necessary exploration and development to reveal these factors. Small mines operate on the hill slopes near Goodlands, the surrounding countryside offering a small domestic market, as it is relatively devoid of trees. Competition however is keen from the large scale mines of southern Saskatchewan, and their hold on the larger potential market of Brandon and Winnipeg, has discouraged exploration and development of the Manitoba deposits.

Present knowledge of the deposit is largely confined to coal seams which outcrop in gullies, or have been penetrated by water wells. These occurrences lie in a line from the International Boundary for a distance of about 9 miles to the north, and from thence for some 27 miles along the northern slopes of the mountain, to its eastern bend. The seams are of the same horizon, but no correlation has been made to show that the occurrence consists of a single seam. The seams are probably of the same horizon as the lowest seams in the main Saskatchewan deposit. Evidence is not available to show that the seams are

continuous over a large area, and it is possible that they occur as lense-like isolated deposits comparable to those of the Wood Mountain-Willowbunch district in Saskatchewan. The quality of the coal is comparable to the Saskatchewan lignite coals, a typical analysis giving the following result:

		(As received basis)
Moisture	Per cent	35.0
Ash	Per cent	7.1
Volatile Matter	Per cent	25.6
Fixed Carbon	Per cent	32.3
Sulphur	Per cent	0.5
Calorific Value	B.t.u./lb.	6,660

The seams are of commercial thickness in a few localities only, generally occurring less than 3 feet in thickness. In these few localities the deposit offers possibilities of underground and stripping operations, but any major development is conditioned by the more favourable conditions in the Saskatchewan coalfields where thicker seams lie under less depth of cover.

The Commission is advised that it is reasonable to assume an area of about 20 square miles to be underlain by coal of commercial thickness, and Dr. MacKay for estimate purposes has so assumed. The figures included in the estimate (see Table 1, Appendix A) are no more than an indication of the relative value of the deposit. They show that it is of purely local significance.

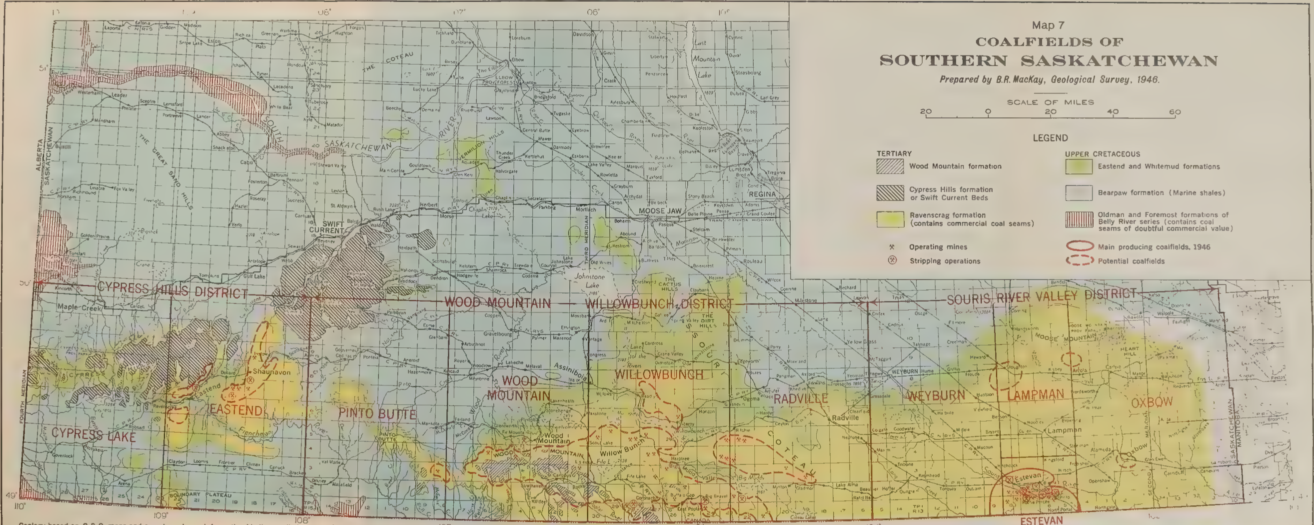
PROVINCE OF SASKATCHEWAN

Large areas in Southern and Western Saskatchewan are underlain by coal-bearing formations. The productive coal measures in Southern Saskatchewan all occur in the Ravenscrag formation which is of early Tertiary (Paleocene) age and represent the northern fringe of a large coal basin covering approximately 60,000 square miles which has its centre in North Dakota in the United States of America. The productive measures of Western Saskatchewan are of Upper Cretaceous age. They constitute the Oldman formation which lies about 1,200 feet below the Ravenscrag formation. These productive measures form an eastward extension of sediments of the same geological age that underlie large areas of Eastern Alberta. They differ, however, from the Alberta measures in that, in Alberta, these measures are all of fresh water origin and normally carry well developed coal seams whereas, in Saskatchewan, they are generally brackish or of marine origin and the seams are thinner and of inferior quality. All the Tertiary coal deposits of Saskatchewan are of lignitic rank whereas the Upper Cretaceous deposits vary from sub-bituminous "C" to lignite. In comparison with the Cretaceous, however, the Tertiary deposits are of much greater significance in respect to both present and future mining operations in Saskatchewan.

Southern Saskatchewan

As will be seen from Map 7, the Tertiary productive coal measures all occur south of latitude 50° and underlie a total area of about 10,000 square miles in an irregular belt extending from near the Manitoba boundary to Alberta. Over most of this area a mantle of glacial drift, ranging from a thin veneer to a thickness of more than 300 feet, conceals the coal measures, a feature which has hindered the acquisition of intimate knowledge of the extent and nature of the belt and the development of mining operations. The belt is continuous from the Manitoba border to beyond Wood Mountain with the exception of a relatively small enclosed area in the central section near Radville, where pre-glacial erosion has removed the coal measures and exposed older barren rocks. In the western section of the belt the measures have been severely dissected by erosion and occur as a series of isolated deposits.

Available evidence suggests that the Estevan area was the centre of deposition of the Saskatchewan Tertiary deposits, the basin originally extending westward to include the Cypress Hills district and eastward into Manitoba but



Geology based on G.S.C. maps and reports, and map information kindly supplied by Imperial Oil Limited, and the Saskatchewan Department of Natural Resources and Industrial Development.

To accompany Report by the Royal Commission on Coal, 1946.

gradually narrowing to the Estevan area. Thus in the Estevan area, where the coal measures have their maximum development, eight seams, seven of which are 4 feet or more in thickness, occur within a stratigraphic interval of 750 feet. A hundred miles to the west in the Wood Mountain-Willowbunch district there are only 5 seams ranging in average thickness from 3 to 6 feet in an interval of 410 feet. Westward, in the Cypress Hills district the number of seams is further reduced to three occurring in 110 feet of strata and the seams are generally thinner. Again, the fact that the coal seams of the Cypress Hills district are correlated with the lower seams of the Wood Mountain-Willowbunch district and that the uppermost seams of both districts are overlain by later Tertiary non-coal bearing formations indicates that the coal seams were deposited in a progressively diminishing basin. It should be noted that, although some of the seams in the Wood Mountain-Willowbunch district have been traced for many miles, the seams do not occur as continuous beds but as a series of detached lense-like deposits lying at the same geological horizon. This would suggest that the coal basin during the periods of deposition consisted of a series of separate shallow depressions in which accumulated the coal forming vegetal matter. Available evidence suggests that the four uppermost seams now being mined in the Estevan area are younger than any of the seams in the Wood Mountain-Willowbunch district, with the possible exception that the lowest of the four, the Taylorton seam, may lie at the same horizon as the uppermost seam of the latter district. It also suggests that the uppermost seams of the Wood Mountain-Willowbunch district are younger than any of the seams of the Cypress Hills district. This is to be expected, in that the Estevan area formed the centre of the basin.

A characteristic feature, however, of the Saskatchewan Tertiary deposits is the folding and subsequent erosion which has occurred since deposition. At the present time the coal measures do not continuously dip either eastward to the Estevan basin or southward to the centre of the main basin in North Dakota as the above description of the original structure of the field would suggest. Due to subsequent folding, the coal measures occur in two structural depressions or troughs that lead into the central part of the main basin. One of these depressions extends southward from the Lampman through the Estevan area and the other extends from the Cypress Hills district eastward with a gentle plunge through Wood Mountain into the Willowbunch area where it curves southward into the United States. These two depressions are separated by a broad south-easterly plunging anticlinal structure which has its summit near Radville where erosion has completely removed the coal measures. Erosion later removed the coal measures from the areas which were elevated at the time of folding so that the reserves of the field are largely confined to the areas of the structural depressions which escaped the effects of erosion. The importance of these factors is readily apparent in Dr. MacKay's estimate of the Saskatchewan reserves (see Table 9, Appendix A) and a comparison with previous estimates of the field.

The chief centre of mining development in this belt of Tertiary deposits is the Estevan area which lies, as will be seen from the map, along the International Boundary in the centre of Souris River Valley district. With few exceptions no seams outcrop in the Souris Valley district outside of the Estevan area and no mining operations have taken place. The presence of the coal bearing formation over an area of about 4,500 square miles has been established by the records of hundreds of water-wells and boreholes which have been put down in this district, of which 1,350 square miles are known to contain coal not less than 3 feet in thickness.

The main centres of the Estevan area are Estevan, Bienfait, Taylorton and Roche Percée, the area being connected with Moose Jaw by the Soo line of the C.P.R. and with Regina by the C.N. Railways. Connections with the Brandon and Winnipeg markets are provided by the C.P.R. The area of the actual coal deposit is typical topographic "bad land", but immediately to the north fair farm lands exist.

The four seams being worked in the area in descending order have average thicknesses of 5, 5, 7 and 10 feet and are separated by strata averaging 52, 20 and 25 feet. The uppermost seam is found only in the highest ground south of Souris River and covers a maximum area of about 20 square miles. No. 2 Seam is best developed at Roche Percée south of Souris River and underlies an area of about 30 square miles. No. 3 Seam, the Estevan Seam, has a relatively shallow overburden north of the Souris Valley and has been extensively mined by large stripping operations. The seam underlies about 95 square miles. Seam No. 4, the Taylorton Seam, is the lowest seam being mined and is probably the most continuous and extensive of the seams. It is thought to underlie about 150 square miles. A deep borehole at Taylorton penetrated four seams having thicknesses of 2, 4, 4 and 4 feet and depths of 130, 337, 546 and 573 feet, and evidence from the records of numerous water-wells shows that these seams underlie an extensive area. No anxiety as to reserves was expressed by the operators and the evidence suggests that there is sufficient coal in the area to maintain production at the current level for many years. Large scale stripping operations will eventually deplete the reserve of shallow-lying coal, which is largely confined to No. 3 Seam, and the long-term life of the field is undoubtedly related to underground development of Seams Nos. 1, 3 and 4.

The next most important reserves of the Tertiary belt occur in the Wood Mountain-Willowbunch district further to the West. Of this district, 4,200 square miles are underlain by Ravenscrag coal-bearing formation. Evidence is insufficient to establish that all this area is underlain by coal of commercial thickness but the records available show that at least 1,000 square miles contain one or more seams over three feet in thickness. Whereas it is not known whether the seams continue in full thickness in every section of this 1,000 square miles, over much of the area at least five seams occur, ranging in thickness from 5 to 15 feet. They have been traced in some instances for a distance of over 50 miles.

This 1,000 square mile area, as will be seen from the map, is an elliptical-shaped area occurring in roughly the centre of the Wood Mountain-Willowbunch district. It extends from the western end of Wood Mountain eastward for some 550 miles beyond Big Muddy Lake and from near the International Boundary to the north side of Willowbunch lake near Viceroy. The centre of the main reserves lies to the north of Big Muddy lake. Small scale mining has been carried out in the area, notably at Coronach, Buffalo Gap, Harptree and Willowbunch, communication with the main transcontinental Railway lines for these centres being provided by the C.N.R. and C.P.R. branch lines from Moose Jaw. The Commission is advised that the reserves in the area are substantial and that in a number of localities may be suitable for large scale stripping operations similar to those presently being conducted in the Estevan field.

As will be seen from the map and Dr. MacKay's estimate, the reserves of the Cypress Hills district, further to the southwest, are much less than those of the previously mentioned district. About 900 square miles of the Cypress Hills district is underlain by coal-bearing formation. The formation contains two seams of mineable thickness, but there is insufficient evidence to show that these are continuous at mineable thickness over much of the district. The main reserves are believed to occur in the Shaunavon and Eastend areas, those at Shaunavon occurring to the north and southwest of the town of Shaunavon and those of the Eastend area occurring to the north and south of Swift Current Valley near Eastend. The reserves of these areas are being developed on a small scale for local domestic purposes.

As previously mentioned, all the coals of the Tertiary belt in Saskatchewan classify as lignite. The following table indicates analyses of the coals mined in the various districts:

District or Area	Proximate Analysis (As received basis)				Sulphur	Calorific Value	Softening Temp. of Ash
	Moisture	Ash	Volatile Matter	Fixed Carbon			
	Per cent	Per cent	Per cent	Per cent	Per cent	B.t.u./lb.	°F.
Souris Valley District—							
Bienfait	35	6.1	26.1	32.8	0.4	7,345	2185
Roche Percée	35	6.5	26.4	32.1	0.5	7,420	
Estevan	35	9.3	25.1	30.6	0.3	6,905	2120
Wood Mountain—Willowbunch District	40	8.2	24.6	27.2	1.0	6,175	2275
Cypress Hills District	40	8.2	25.7	26.1	1.0	5,880	

Western Saskatchewan

Geological mapping has shown that about 30,000 square miles in western Saskatchewan are underlain by the Oldman Formation, which is of Upper Cretaceous age and which in Alberta is the uppermost coal-bearing formation of the Belly River Series. This area is triangular-shaped with its base along the Alberta border and its eastern boundary extending roughly from Maple Creek on the south to Saskatoon and thence northwestward to Lloydminster. Coal seams ranging up to 13 feet in thickness have been reported as occurring at numerous widely separated localities. These seams occur in natural exposures or have been penetrated by water-wells and deep borings. A deep borehole at Maple Creek, for example, penetrated a 4-foot seam at 192 feet and a 7-foot seam at 235 feet.

The great majority of these occurrences lie within 11,000 square miles in which the Oldman Formation immediately underlies the glacial drift. This area is largely confined to a belt 30 to 80 miles wide that extends from the Alberta border eastward, narrowing to an apex some 75 miles east of Saskatoon. The glacial drift is comparatively shallow, seldom exceeding 50 feet, whereas in the remaining area the coal lies under an additional bedrock cover ranging to a maximum thickness of over 1,000 feet. The most attractive possibilities of this area lie within a 2,500 square mile block centring in the vicinity of Kelfield, Unity, Salvador and Brock, where seams 3 feet, 4 feet, 8 feet and 8 feet have been prospected.

Mining and prospecting have been carried on spasmodically in a number of these localities. These have shown that the deposits were not continuous but were either isolated lens-like deposits, or terminated by faults or removed by pre-glacial erosion. The Commission is advised that data on which to estimate the reserves are very meagre as the behaviour of the seams can only be determined by systematic drilling or by the sinking of shafts due to the concealment of the coal measures by glacial drift. Any estimates therefore must be very approximate and Dr. MacKay's are no more than an attempt to indicate the relative value of these deposits as compared with the Tertiary deposits of southern Saskatchewan and those of the same Upper Cretaceous formation in the related coal areas of Alberta.

PROVINCE OF ALBERTA

As will be seen from Map 8, coal-bearing formations underlie most of the southern half of the Province, and occur both in the Plains and the Rocky Mountain Foothills. These formations contain extensive coal deposits of commercial value. In addition to being the leading coal producing province in Canada, Alberta possesses the major proportion of Canadian coal reserves. These reserves consist largely of bituminous and sub-bituminous coals, but coals of all ranks from lignite to anthracite are represented. The largest reserves in the Province occur in the Foothills immediately adjacent to the mountains and consist mainly of medium and low volatile bituminous coals. The next largest reserves are the high volatile bituminous coals which occur mainly in the outer Foothills nearest the Plains. Extensive deposits of sub-bituminous coals occur in the central Plains area. Small deposits of lignite are found in the southeast and northeast of the Province on the outer rims of the Alberta coal basin, and small areas of anthracite occur at a few localities in front of the Rocky Mountains in the vicinity of Banff.

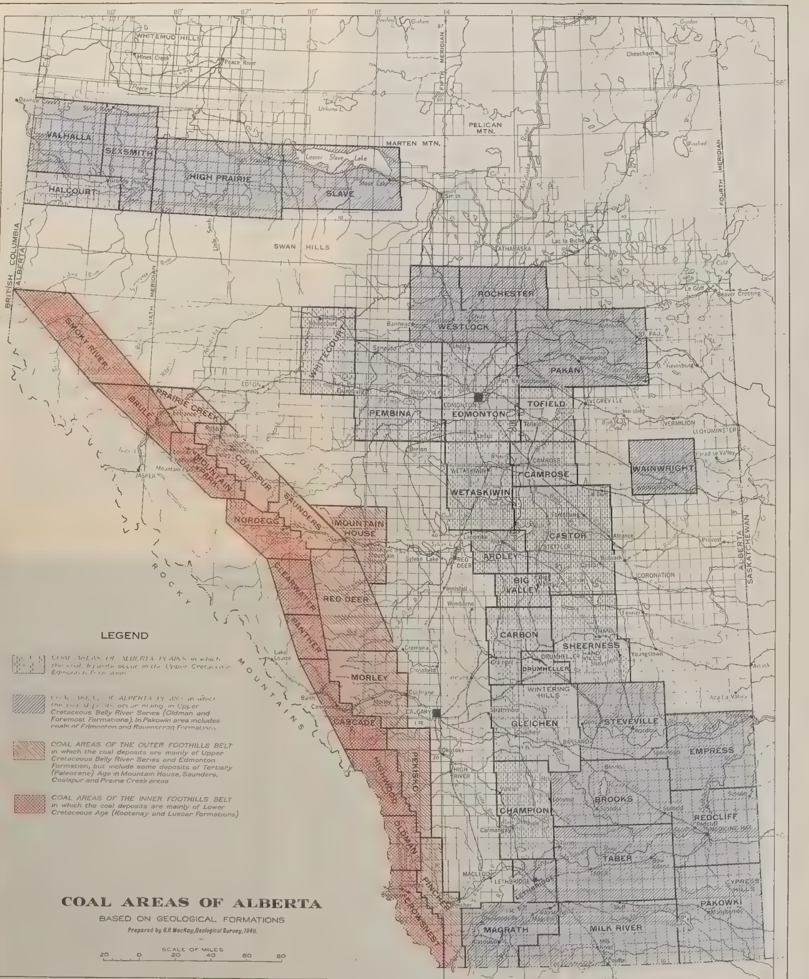
Alberta coals are all geologically much younger than those of the Maritime Provinces. Although Carboniferous sediments of the same Pennsylvanian age as the coal-bearing formations of the Maritimes occur in the Rocky Mountain Foothills, these are of marine origin and do not contain coal. The oldest coal-bearing rocks occurring in Alberta are of Lower Cretaceous age. These occur in the western or inner belt of the Rocky Mountain Foothills and contain the most important deposits of bituminous coal in the Province. Next in age are the coal deposits of Upper Cretaceous age which underlie a large portion of the southern part of the Province and outcrop along the outer Foothills belt of the mountains and over much of the central Plains. The youngest coal deposits are of Tertiary age. They underlie a small area in the Cypress Hills in the south-eastern part of the Province and are believed to form the coal-bearing measures of the important coal deposits which occur in the outer Foothills of central Alberta, in the Prairie Creek, Coalspur, Saunders and Mountain House coal areas.

The coal deposits within these three geological groups differ further in age which is apparent from the six geological formations in which they occur. The coals of Lower Cretaceous age occur in two formations, the Kootenay and Luscar formations. Those of Upper Cretaceous age occur in three formations which, in ascending order, are the Foremost, Oldman and Edmonton formations, the first two of which belong to the Belly River series. Fossil plant evidence indicates that the Tertiary deposits of the two widely separated areas previously noted are both of Paleocene age and are equivalent in age to the lignite deposits of Saskatchewan.

The distribution of the six coal-bearing formations and the characteristics of the coal seams are closely related to the general geological history of this part of Canada. The coal deposits represent vegetation which either grew or accumulated in swamps which successively existed along ancient shorelines bordering rising land areas. All the areas of coal formations during this period were confined to a broad shallow basin trending in a northwesterly direction and lying between the rising land areas of the East and West. In the earliest period of coal formation, this basin extended from northeast British Columbia southeast into the United States. Its eastern limit conformed closely with a line drawn from near Winnipeg, Manitoba northwesterly to Peace River, the western boundary lying a little to the west of the present Rocky Mountain Range. By Tertiary times, the basin was very much more confined in respect to both length and breadth.

Conditions favourable to coal formation were intermittent and these intervals were relatively brief in comparison with periods in which no coal was formed. The areas in which conditions were favourable to coal formation were

MAP 9



COAL AREAS OF ALBERTA
BASED ON GEOLOGICAL FORMATIONS
Prepared by B.R. MacKay, Geological Survey, 1946.
SCALE OF MILES
20 0 20 40 60 80
LEGEND
Cretaceous Belly River Series (Oldman and Foremost Formations). In Pakowki area includes coals of Edmonton and Ravenscrag Formations
COAL AREAS OF THE OUTER FOOTHILLS BELT in which the coal deposits are mainly of Upper Cretaceous Belly River Series and Edmonton Formation, but include some deposits of Tertiary (Paleocene) Age in Mountain House, Saunders, Coalspur and Prairie Creek areas
COAL AREAS OF THE INNER FOOTHILLS BELT in which the coal deposits are mainly of Lower Cretaceous Age (Kootenay and Luscar Formations)
WHITEMUD HILLS
Peace River
PELICAN MTN.
MARTEN MTN.
VALHALLA
SEXSMITH
HIGH PRAIRIE
HALCOURT
SLAVE
Lesser Slave Lake
SWAN HILLS
BRITISH COLUMBIA
ALBERTA
FIFTH MERIDIAN
FOURTH MERIDIAN
SIXTH MERIDIAN
ROCHESTER
WESTLOCK
WHITECOURT
PAKAN
PEMBINA
EDMONTON
TOFIELD
CAMROSE
WETASKIWIN
WAINWRIGHT
CASTOR
ARDLEY
BIG VALLEY
CARBON
SHEERNESS
DRUMHELLER
WINTERING HILLS
GLEICHEN
STEVEVILLE
EMPRESS
BROOKS
CHAMPION
REDCLIFF
TABER
LETHBRIDGE
CYPRESS HILLS
PAKOWKI
MAGRATH
MILK RIVER
SMOKY RIVER
PRAIRIE CREEK
BRULE
MOUNTAIN PARK
COALSPUR
SAUNDERS
NORDEGG
MOUNTAIN HOUSE
CLEARWATER
RED DEER
PANTHER
MORLEY
CASCADE
HIGHWOOD
PEKISKO
OLDMAN
PINCHER
CROWSNEST
ROCKY MOUNTAINS
JASPER
EDSON
CALGARY
RED DEER
MACLEOD
LETHBRIDGE
ALBERTA
SASKATCHEWAN

also limited and their location differed in the various periods. During the periods in which conditions were favourable to the growth or accumulation of vegetation in one area, fresh water sediments and marine shales were being deposited in other areas. These changing conditions arose from an intricate series of earth movements over a long interval of the geological history of the rise of this part of the North American Continent. The general rise of this land area was periodically interrupted by periods of quiescence and recession and even submergence. During periods of emergence, the coal deposits were subjected either to erosion or were covered by coarse sands and gravels from the mountains; whereas during periods of submergence, the deposits were covered by fine clays deposited in embayments of the sea. During some of the periods of the coal formation, volcanic activity resulted in beds of fine volcanic ash and dust being deposited along with the coal-forming vegetation.

The coal deposits of Lower Cretaceous age are not all of the same geological age but are limited to two periods of coal formation. Those of the southern Foothills, extending from the Crowsnest area northwards into the Panther area, belong to the Kootenay formation which had its centre of development in the Crowsnest region of southeastern British Columbia. The sediments and coal seams of this formation decrease in thickness and number to the north and eastward through southern Alberta. Those of the northern area occur in the Luscar formation which extends from the Clearwater to beyond the Smoky River area and has its main centre of deposition in the Mountain Park area. These two formations are separated by a considerable time interval as indicated by the existence of a thick series of coarse sands and a conspicuous thick bed of conglomerate which lies between the two formations. The coal deposits of both of these formations have their greatest development at the mountains and thin rapidly to the east into the Plains area where they are deeply buried beneath younger sediments. For example, in the Fernie area of southeastern British Columbia there are in places 22 seams having an aggregate thickness of 150 feet of coal in a stratigraphic interval of 3,500 feet; whereas at Coleman in the Alberta Crowsnest area, the measures are only 800 feet in thickness and contain a maximum of five seams aggregating about 47 feet of coal. At Bellevue ten miles further east, the measures are reduced to 430 feet with only three seams aggregating about 37 feet of coal. So also in the Luscar formation to the north in the Mountain Park basin there are eight seams of commercial thickness aggregating about 77 feet of coal contained in about 1,200 feet of measures; whereas in the Cadomin-Luscar basin 7 miles to the north there are only three seams aggregating 35 feet of coal in a stratigraphic interval of less than 1,000 feet. Further east in the Plains region coal seams in both of these formations have been penetrated by deep borings but they are thin and the coal is of inferior quality.

The upper Cretaceous coal deposits are separated from the Lower Cretaceous coals by a great thickness of marine shales interspersed by thin non-coal-bearing sandstones which would indicate a long period of submergence in which much of northeastern British Columbia, Alberta and Saskatchewan were covered by the sea.

Following this there was a general emergence of the continent which resulted in the sea being largely expelled from central Alberta to be followed by further periods favourable to the formation of coal in central Alberta and western Saskatchewan. During these periods there were deposited the Foremost, Oldman and Edmonton coal-bearing formations.

These three Upper Cretaceous coal-bearing formations are separated by time intervals which, in the eastern Plains region, are represented by marine sediments indicating further invasions of an arm of the sea from the south and southeast. The sediments separating the Edmonton from the Oldman formation are much more extensive than those separating the Foremost and Oldman

formations. The marine beds separating the Foremost and Oldman formations in the Plains have their greatest development in Saskatchewan and peter out in the central Plains of Alberta. The marine beds separating the Oldman and Edmonton formations cover southern Saskatchewan and continue westward into the Foothills having been traced northward to the Red Deer area. In the Foothills and western Plains beyond the extension of these marine beds, the deposits of Upper Cretaceous age cannot be divided into individual formations but in some areas age relationships have been established on the basis of fossil evidence.

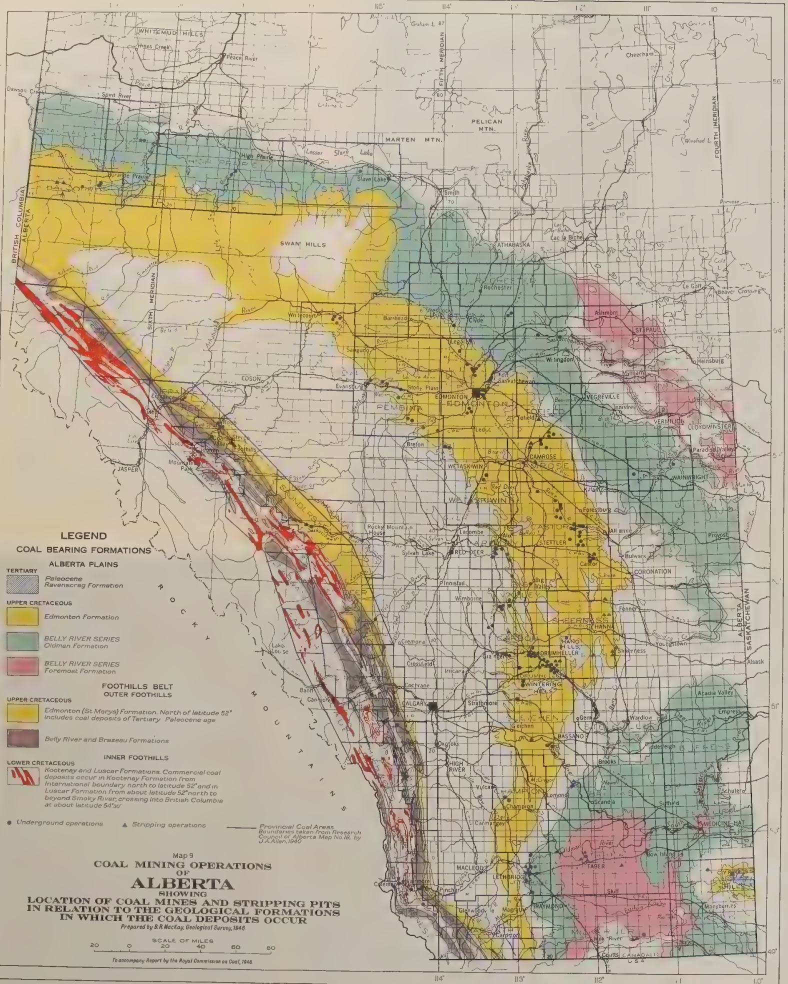
As a result of these fluctuating conditions, the Upper Cretaceous coal deposits are not nearly as well developed or as continuous as those of Lower Cretaceous age and in the eastern areas are known to form thin isolated deposits of inferior quality.

The early Tertiary period was characterized by a further elevation of the Continent with the result that the area of formation of coal was much more confined than in Upper Cretaceous times. The main centre of coal formation in Alberta became the Foothills belt in the central Foothills where occur the important deposits of the Prairie Creek, Coalspur and Saunders areas. The deposits of these areas are of the same age as the deposits of southeastern Alberta which form the western extension of the important Tertiary coal deposits of southern Saskatchewan. These coal forming conditions were succeeded by continued land elevation to the East and the West which resulted in the removal of the coal seams of the upper part of the Edmonton formation in certain areas of the central Plains and thick accumulation of sediments derived from the rising mountains to the West.

The elevation of the rising land area to the West finally culminated in late Tertiary times in the formation of the Rocky Mountains which are characterized by numerous major folds and faults.

As a result of the combination of the foregoing events, embracing the rising Continent in the East and mountain building in the West, there now exists a large structural basin known as the Alberta Syncline. This basin has its centre near Mountain House, its axis extending from the International Boundary south of McLeod, northwesterly closely paralleling the trend of the Foothills. The youngest formations occur in the centre of the basin and progressively older formations occur in the outer rims of the basin. This is apparent from the geological map of Alberta (Map 9) and the arrangement of the fifty coal areas delineated by the Provincial Government which appears on Map 8.

The effects of mountain-building forces on the coal deposits of this section of Canada are outstanding and are particularly evident along the Rocky Mountain Foothills belt which forms the western limb of the Alberta Syncline. In this area the coal measures were subjected to intensive dynamic pressure accompanying the formation of the mountains and as a result, are highly folded and faulted. The seams in the belt are, as a rule, steeply inclined with a general northwesterly trend parallel to the mountain front. Local irregularities exist in respect to trend and dip due to the presence of numerous plunging folds. In other places, the seams are either cut off by faults or are so thinned by pinching as to be unworkable. In a number of cases, folding and thrust faulting has resulted in a large concentration of coal near the surface giving rise to valuable deposits which would otherwise not exist. Examples of this are the coal deposits in the Cadomin-Luscar basin in the mountain area and the even more extensive concentration of coal along the fault of the Sterco—Coal Valley deposit in the Coalspur area. In the latter instance, coal 50 to 120 feet in thickness is being recovered by open-cut operations, the pits in places being about 600 feet wide and having a depth of over 250 feet. For the same reasons the coal in many areas in the Foothills belt is severely crushed which has, in many cases, seriously affected mining operations and generally has the effect of reducing the percentage of recovery to a very low figure owing to the difficulty of marketing fine coals


LEGEND
COAL BEARING FORMATIONS
ALBERTA PLAINS
TERTIARY
Paleocene
Ravenscrag Formation
UPPER CRETACEOUS
Edmonton Formation
BELLY RIVER SERIES
Oldman Formation
BELLY RIVER SERIES
Foremost Formation
FOOTHILLS BELT
OUTER FOOTHILLS
UPPER CRETACEOUS
Edmonton (St Marys) Formation. North of latitude 52° includes coal deposits of Tertiary Paleocene age
Belly River and Brazeau Formations
INNER FOOTHILLS
LOWER CRETACEOUS
Kootenay and Luscar Formations. Commercial coal deposits occur in Kootenay Formation from International boundary north to latitude 52° and in Luscar Formation from about latitude 52° north to beyond Smoky River, crossing into British Columbia at about latitude 54°30'
Underground operations
Stripping operations
Provincial Coal Areas
Boundaries taken from Research Council of Alberta Map No.18, by J.A.Allen, 1940
Map 9
COAL MINING OPERATIONS
OF
ALBERTA
SHOWING
LOCATION OF COAL MINES AND STRIPPING PITS
IN RELATION TO THE GEOLOGICAL FORMATIONS
IN WHICH THE COAL DEPOSITS OCCUR
Prepared by B.R.MacKay, Geological Survey, 1946
SCALE OF MILES
20 0 20 40 60 80
To accompany Report by the Royal Commission on Coal, 1946
ROCKY MOUNTAINS
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
FIFTH MERIDIAN
FOURTH MERIDIAN
SIXTH MERIDIAN
EDMONTON
CALGARY
MEDICINE HAT
LETHBRIDGE
DRUMHELLER
CANADA
U.S.A.

from the Alberta field. On the other hand, the folding and faulting to which the measures have been subjected have brought to the surface and made accessible for easy mining deposits that would otherwise have been under too great a cover to permit recovery. Examples of this occur in practically all of the coal fields under development in the Foothills belt. A further advantage of this folding and faulting in the Foothills belt is the general exposure of the coal measures and their contained coal seams. Assisted by the effects of erosion, this has greatly facilitated the determination of the reserves. This feature contrasts with the difficulties of determining boundaries of the relatively flat lying deposits of the Plains region where the measures are generally covered by thick glacial drift and are generally exposed only where major streams have cut deep channels.

A further feature of the influence of mountain-building pressure in respect to Alberta coals is that the rank of these coals does not conform to their geological age. Two factors normally determine the rank of a coal, namely, its geological age and the pressure to which it has been subjected, and in general it holds that the geologically older coals are more mature and of higher rank than are the younger coals. In Alberta there is a general progression in rank across the Plains westward into the Foothills and coals geologically younger in the regions of the Foothills have reached greater maturity than geologically older coals further removed from the mountains. Essentially the influence of mountain-building pressures on the metamorphism of the coal beds has been of overwhelming importance. It is interesting to note that the coal areas at the northern and southern extremities of the synclinal basin where the Plains deposits are closest to the Mountains, namely, at Magrath, Lethbridge and Halcourt, the coals are also of higher rank than coals of the same geological age further removed from mountain stresses.

As previously maintained, the Alberta Government has designated as coal areas fifty districts underlain by coal. The boundaries of these areas were designed to conform to boundaries of the geological formations in which deposits of similar geological age and characteristics occur. It should be noted that these coal areas are not coal fields, which in the Plains area are very difficult to define due to the lack of structural boundaries; nor does the size of the area, in any way, indicate its relative importance.

In the following discussion of Alberta coal reserves, these fifty coal areas have been arranged for convenience under four groupings:

1. The Inner Foothills belt, in which the deposits occur mainly in Lower Cretaceous formations, and the coals are largely of medium and low volatile bituminous rank.
2. The Outer Foothills belt, in which the deposits are mainly of Upper Cretaceous and Tertiary ages, and the coals are largely of high volatile bituminous rank.
3. The Plains region, in which the deposits occur mainly in the Belly River formations of Upper Cretaceous age, the coals ranging in rank from lignite to high volatile "B" bituminous.
4. The Plains region, in which the deposits occur largely in the Edmonton formation of Upper Cretaceous age in which the coals classify mainly as sub-bituminous.

Inner Foothills Belt

The Inner Foothills belt includes ten coal areas which, from south to north, are the Crowsnest, Oldman, Highwood, Cascade, Panther, Clearwater, Nordegg, Mountain Park, Brulé and Smoky River areas. Coal mining operations in these areas have been largely confined to the vicinity of three mountain passes traversed by the Canadian Pacific and Canadian National Railways and two areas penetrated by two branch lines of the Canadian National Railways. These areas are Crowsnest, traversed by the southern transcontinental line of

the Canadian Pacific Railways; the Cascade coal area, crossed by the main transcontinental line of the Canadian Pacific Railways; the Brulé area, traversed by the main line of the Canadian National Railways; the Mountain Park area, reached by the Canadian National Railways Coal Branch line from Edson; and the Nordegg area, reached by a further Canadian National Railways branch line from Red Deer. At present no mining development is taking place in the Brule area, mining operations having been terminated due to the badly crushed nature of the coal, faulting and difficulties in marketing the low volatile product. As might be expected, the coals of this area form the main source of railway coal supply in Western Canada.

As previously noted, this coal-bearing belt contains the most important coal reserves of Alberta. The Lower Cretaceous coals of this belt are mainly of medium and low volatile bituminous rank. The ash content of the coals is considerably higher than most of the Maritime coals, whereas in contrast their sulphur content is negligible, this low sulphur content being a feature of all Alberta coals. The calorific values of the coals range from 12,490 to 13,930 B.t.u./lb. and is comparable with the coals of the Sydney coal field. Their fusion point of ash, however, is much higher ranging from 2,400 to 2,900 degrees Fahrenheit. The coals of this belt are generally friable, notably in regard to developed areas, in the Cascade, Nordegg, and Brulé areas. The friable nature and non-coking qualities of the low volatile coals have impaired their use for railway-locomotive purposes but the medium and high volatile coals are good coking coals and have proved suitable for all phases of industrial use. Detailed analyses of the coals in the various areas of this and other belts are given in a report on the Coals of Alberta by Edgar Stansfield and W. Albert Lang (Report Number 35, Research Council of Alberta, 1944).

All the areas in this belt have been mapped by the Geological Survey and much more is known of the deposits in this region than any of the other coal-bearing areas of Alberta. Somewhat less is known about the deposits in areas in this belt where development has not taken place, particularly in the Panther area in the southern portion of the Clearwater area. However, it is known that the most extensive reserves along this belt occur in the areas where the Kootenay and Luscar formations have their greatest development. The main reserves of the Kootenay formation are in the Highwood area with lesser concentrations occurring in the Cascade, Oldman and Crowsnest areas. The main reserves of the Luscar formation lie in the Mountain Park area, with lesser deposits occurring in the adjoining Brulé and Nordegg areas. The coal areas having the least reserves are the intermediate Panther and Clearwater areas, in which occur the limits of coal formation of the Kootenay formation in the south and the Luscar formation in the north. These observations are borne out in the evidence on coal reserves submitted by the Alberta Government and by the following figures from the Commission estimate, details of which appear in Table 11, Appendix 00.

Area	Mineable Coal		Recoverable Coal	
	Probable	Possible (Additional)	Probable	Possible (Additional)
	(Thousands of net tons)			
Crowsnest	3,157,280	872,480	1,578,640	436,240
Oldman	2,811,200	397,600	1,405,600	198,800
Highwood	3,762,080	1,684,480	1,881,040	842,240
Cascade	2,228,800	660,800	1,114,400	330,400
Panther	431,200	128,800	215,600	64,400
Clearwater	224,000	124,320	112,000	62,160
Nordegg	1,892,800	868,000	946,400	434,000
Mountain Park	2,816,800	554,400	1,408,400	277,200
Brulé	761,600	683,200	380,800	341,600
Smoky River	2,250,000	1,349,600	1,120,000	674,800
Total—Inner Foothills Belt	20,325,760	7,323,680	10,162,880	3,661,840

It is readily apparent that the reserves of the various areas in this belt are very substantial. The companies operating in this belt informed the Commission they are satisfied that their reserves are sufficient to allow operations at the current maximum level of production and at present sites for over 100 years. This estimate does not include further reserves which would be available by starting operations at new sites contiguous to present operations or those which would be available with additional railway construction. These operators, through their organization, The Western Canada Bituminous Coal Operators' Association, presented the following statement:

> With respect to development and reserves at the present operating sites and to depths of cover generally not exceeding two thousand feet, the consolidated returns show:
>
> 1. Known reserves in tons in present working areas and development*
>
> | Reserves | Estimated percentage of Recovery | Recoverable |
> |---|---|---|
> | 78,108,000 | 74 | 54,449,550 |
>
> On the basis of the maximum actual annual production (year 1942) this represents eleven years' operations.
>
> 2. Additional reserves as in No. 1 but based on some knowledge of continuity of seams provided by drilling or prospecting
>
> | Reserves | Estimated percentage of Recovery | Recoverable |
> |---|---|---|
> | 339,473,860 | 70 | 233,682,400 |
>
> On the same basis as No. 1, this would provide for an additional fifty years' operations.
>
> 3. Estimated additional reserves, assuming continuity of seams on structural evidence only
>
> | Reserves | Estimated percentage of Recovery | Recoverable |
> |---|---|---|
> | 418,826,000 | 74 | 311,414,600 |
>
> This would provide for a further sixty-five years of operations at present operating sites.

*This estimate includes the reserves of the Crow's Nest Pass Coal Company, Fernie, B.C.

It is abundantly clear from the foregoing that the coal deposits of the Inner Foothills belt represent most extensive reserves of low and medium volatile bituminous coal. Only a limited portion of these reserves is under mining development and we feel it is impossible to dismiss further consideration of this area without reference to the possibility of new developments.

During the past two years public attention has been drawn to the Highwood area which lies about 60 miles southwest of Calgary. Two companies have been sponsoring prospective mining operations in this area, Ford Highwood Collieries Limited on land known as the Ford property and Allied Industrials Limited on land known as the Burns' property. In connection with the venture of Ford Highwood Collieries Limited a railway charter was secured from the Province of Alberta and it was proposed to finance both railway construction and the development of a mine by capital subscribed by the public. Allied Industrials Limited, on the other hand, sought extensive assistance from the Dominion Government for the development of its holdings both in respect to the construction of a railway and the raising of capital.

Both of these ventures contemplated in a very large measure a domestic market for the coal they would produce. The limited market for Alberta coals in the Prairie Provinces and the northwestern sections of the United States and the difficulties inherent in moving these coals to the densely populated portion

of central Canada are discussed in later chapters on Markets and Transportation. In brief, the bituminous operations in Alberta are dependent upon the railways for a market of roughly 70 per cent of their production and the existing mines are more than capable of meeting the requirements of the normal market. Transportation assistance in the form of subventions has been provided to absorb their surplus production in Ontario markets to which normally they would not have access. Similar assistance has been given to the Alberta sub-bituminous mines which are almost solely dependent on a domestic market.

Presumably the proposed new mines in the Highwood area would operate in competition with established mines in Alberta and transportation assistance would be required to provide access to the Ontario market. Apart from a relaxation during recent war years, the benefits of transportation subvention were limited to the mines operating prior to December 31, 1930.

Both Ford Highwood Collieries Limited and Allied Industrials Limited have emphasized the quality of the Highwood coals claiming that they are fully comparable if not superior to Pennsylvanian anthracite and Pocahontas low volatile coals imported from the United States. Particular emphasis has been placed on the physical structure of the coal. It has been referred to as "hard" coal suggesting in this way that the coal is comparable to imported anthracite. After full investigation the Commission is satisfied that the Highwood area constitutes a very valuable deposit of low volatile bituminous coal. We are equally convinced that there is no evidence to suggest that the coals of this area when mined will fulfill the claims of the promoting companies. These coals are of the same geological horizon as those of the Cascade area now being mined at Canmore and there is some evidence to show that the Highwood coals are somewhat inferior in grade to the Cascade coals, principally in respect to ash content. It is particularly important to note that the operator at Canmore is obliged to briquette one-third of the mine output owing to the extreme friability of the coal. Again, friability in large part has limited the Ontario market for Cascade coals to briquettes owing to the large percentage of degradation accruing from transhipment. The Commission is convinced that if these ventures result in the opening of new mines, the coals produced will exhibit marked friability thus presenting serious marketing problems.

The Commission does not suggest that a project such as Ford Highwood Collieries Limited should be prevented by Governmental action from risking its capital on the development of this area but in the circumstances there is no valid reason for extending Government assistance other than the transportation subventions available to existing operators.

Outer Foothills Belt

The Outer Foothills belt includes eight coal areas which, from south to north, are the Pincher, Pekisko, Morley, Red Deer, Mountain House, Saunders, Coalspur and Prairie Creek areas. As in the instance of the Inner Foothills belt, mining operations are largely confined to the areas traversed by the main line of the Canadian Pacific and Canadian National Railways and the two branch lines of the Canadian National Railways from Edson and Red Deer; although small mines have operated intermittently in the other coal areas to supply local requirements for coal.

The coal areas of this belt include deposits of the Belly River, Brazeau and Edmonton formations of Upper Cretaceous age and the Coalspur deposits of Tertiary age. The Belly River and Edmonton formations outcrop intermittently in narrow bands in the Pincher Creek, Pekisko and Morley areas, being separated in this area by the Bearpaw shale formation. In the Red Deer area, these coal formations cannot be separated, and in the Saunders, Coalspur and Prairie Creek areas they are grouped in the Brazeau formation. The important coal deposits in the Saunders, Coalspur and Prairie Creek areas occur in younger

beds which, on the basis of plant fossils, are considered to be of Tertiary age. These Tertiary coal-bearing beds are believed also to occur in the Mountain House area.

It will be noted that this belt of coal areas does not extend as far northward as the Inner Foothills belt. The reason for this is apparent from previous discussion, namely, that conditions favourable to coal formation in Upper Cretaceous and Tertiary times were more restricted than those in the Lower Cretaceous age.

The deposits of this belt comprise high volatile "B" bituminous and high volatile "C" bituminous coals, the Upper Cretaceous coals being largely of high volatile "B" bituminous and the younger Tertiary coals being largely high volatile "C" bituminous. There is a wide range in the quality and physical characteristics of the coals in this belt. Most of them are of hard structure and will withstand handling and exposure to weather, whereas other coal seams in the same area, where they have been subjected to faulting, are very friable. As a rule, these coals have a lower ash content than the majority of the coals of the Inner Foothills belt and a somewhat higher ash content than that of the coals of the central Plains. These Outer Foothills belt coals are not good coking coals and find their most ready market as a domestic fuel. For railway-locomotive use they are blended with the coals of the Inner Foothills belt.

With the exception of the Mountain House area and part of the Red Deer area, all the areas in this part have been mapped by the Geological Survey and portions of it have been mapped by the Provincial Government. However, due to the heavy blanket of glacial drift that conceals the bedrock over much of this region, it is more difficult to trace the coal seams and to determine their variations in thickness and attitude than in the areas of the Inner Foothills belt. Sufficient, however, is known of the coal deposits of each of these areas of the Outer Foothills belt to establish beyond doubt that the reserves are very substantial. This was the submission of the Provincial Government and is apparent from the estimate prepared for the Commission (Table 12, Appendix A) which gives the following figures:

Area	Mineable Coal		Recoverable Coal	
	Probable	Possible (Additional)	Probable	Possible (Additional)
	(Thousands of net tons)			
Pincher	156,800	201,600	78,400	100,800
Pekisko	728,000	593,600	364,000	296,800
Morley	375,200	554,400	187,600	277,200
Red Deer	420,000	520,800	210,000	260,400
Mountain House	8,960	35,840	4,480	17,920
Saunders	1,275,680	874,720	637,840	437,360
Coalspur	3,376,800	576,800	1,688,400	288,400
Prairie Creek	240,800	173,600	120,400	86,800
Total—Outer Foothills Belt	6,582,240	3,531,360	3,291,120	1,765,680

The Coalspur area, which, as will be seen from the foregoing estimate, possesses by far the largest reserves, is the largest producing area in this belt. This production is derived from both underground mining and stripping or open-cut operations. Only very limited reserves are available for recovery by stripping operations and recovery of reserves generally in this belt will be by underground operations.

Plains Region (Belly River)

As may be seen from Map 8, the Plains region, in which the coal deposits occur mainly in the formations of the Belly River series, includes seventeen coal areas. From south to north, these are Magrath, Lethbridge, Milk River,

Pakowki, Taber, Redcliff, Brooks, Empress, Steveville, Wainwright, Pakan, Westlock, Rochester, Slave, High Prairie, Sexsmith and Valhalla. The Lethbridge area, the smallest of these, is the most important both in respect to present development and reserves for future operations.

With the exception of the Taber area, very limited development of the reserves has taken place elsewhere in this Plains region. In many areas no mining has taken place.

The coals in this region present a wide range in rank from lignite at the Saskatchewan border in the Pakowki area to high volatile "B" bituminous in the Magrath area. In most of the areas, the coals are of sub-bituminous rank but the coals of the Lethbridge area are high volatile "C" bituminous. The coals of the region also show wide range in physical characteristics. The majority of them do not withstand exposure to weather but the coals of the Lethbridge and Magrath areas are more compact and withstand exposure. The coals of these two areas closely resemble those of the Outer Foothills belt, the improvement in the quality of the coal being due to proximity to the mountains.

Relatively little is known as to the coal reserves of this region, as the bedrock is largely concealed by a blanket of alluvium and glacial drift. The region has been extensively mapped by the Geological Survey or by the Province but such investigations have yielded very little data respecting the number, thickness and continuity of the coal seams in these areas due to the flat-lying nature of the coal measures, and the fact that very few of the streams have cut deep enough channels through the glacial drift to expose the underlying coal-bearing rocks. Existing mines and prospects and records of water wells and deep borings for oil and gas have formed the main source of information on which to base estimates of coal occurring in these areas. It is apparent that estimates in such instances are only approximations. The Province indicates that the reserves in all of the areas in the region are substantial and this is confirmed in the estimate prepared for the Commission (See Table 13, Appendix A).

Area	Mineable Coal		Recoverable Coal	
	Probable	Possible (Additional)	Probable	Possible (Additional)
	(Thousands of net tons)			
Magrath	437,900	39,200	218,950	19,600
Lethbridge	678,720	144,480	339,360	72,240
Milk River	428,960	282,240	214,480	141,120
Pakowki	254,240	57,120	127,120	28,560
Taber	408,800	229,600	204,400	114,800
Redcliff	51,520	78,400	25,760	39,200
Brooks	182,560	425,600	91,280	212,800
Steveville	16,800	33,600	8,400	16,800
Empress	20,160	30,240	10,080	15,120
Wainwright	6,720	20,160	3,360	10,080
Pakan	13,440	20,160	6,720	10,080
Westlock	26,880	47,040	13,440	23,520
Rochester	13,440	20,160	6,720	1,080
Slave	10,080	16,800	5,040	8,400
High Prairie	15,680	23,520	7,840	11,760
Sexsmith	16,800	13,440	8,400	6,720
Valhalla	30,240	20,160	15,120	10,080
Total—Alberta Plains (Belly River Series.)	2,612,940	1,501,920	1,306,470	750,960

There are doubtless many local occurrences in the region suitable for stripping operations, but the principal recovery will be derived from the coal seams occurring in the Oldman formation and by underground operations. The reserves in each of the operating localities are sufficient to allow many years of operation.

Plains Region (Edmonton)

The Plains region underlain by the Edmonton formation includes 15 areas, which from south to north are the Champion, Gleichen, Drumheller, Sheerness, Carbon, Big Valley, Castor, Ardley, Wetaskiwin, Camrose, Tofield, Edmonton, Pembina, Whitecourt and Halcourt areas. Large areas are underlain by this formation between the areas indicated and the Foothills belt, but in the central part of the Alberta Syncline the coal deposits lie at too great a depth to be of commercial importance.

Mining operations in the Plains region have been largely concentrated in the Drumheller and Edmonton areas, the annual production from Drumheller representing about two-thirds of the total production from this Plains region. Production from these fields is largely for domestic consumption, and in most of the areas outside of the Edmonton and Drumheller areas, only limited or intermittent mining has been carried on.

With the exception of the Halcourt area, all the coals in these areas are of sub-bituminous rank. In the Halcourt area, the coal ranks as high volatile "C" bituminous. The coals of this region have a relatively low ash content and exhibit a wide range in respect to moisture content, the percentage of moisture being directly related to the distance of the various areas from the mountains. Thus the coals of the Edmonton area have a moisture content of about 25 per cent, whereas that of the Drumheller coals is less than 19 per cent. In contrast to the coals of the Inner Foothills belt, the fusion point of ash of these Edmonton formation coals is low. None of these coals are coking coals. They are very friable and slack on exposure to weather.

The Geological Survey has mapped a considerable part of this Plains region, but the most intensive studies of these coals have been carried out by the Province. These investigations have shown that the Edmonton formation in the central part of this belt has a thickness of 1,224 feet, and contains 14 coal seams having an aggregate thickness of 62 feet. They have also shown that over much of the area the upper portion of the Edmonton formation and its contained seams have been removed by erosion.

More is known of these deposits than those of the Plains region underlain by the formations of the Belly River series. However, glacial drift again offers a serious handicap in securing essential data on which to base estimates. Evidence submitted by the Province, however, shows that the coal reserves in each of these areas are large. The estimate prepared for the Commission (Table 14, Appendix A) gives the following tonnages:

Area	Mineable Coal		Recoverable Coal	
	Probable	Possible (Additional)	Probable	Possible (Additional)
	(Thousands of net tons)			
Champion	67,200	16,800	33,600	8,400
Gleichen	58,800	16,800	29,400	8,400
Drumheller	994,000	324,800	497,000	162,400
Sheerness	235,200	26,880	117,600	13,440
Carbon	302,400	50,400	151,200	25,200
Big Valley	89,600	44,800	44,800	22,400
Castor	336,000	26,800	168,000	13,400
Ardley	280,000	20,160	140,000	10,080
Wetaskiwin	56,000	28,000	28,000	14,000
Camrose	112,000	16,800	56,000	8,400
Tofield	246,400	33,600	123,200	16,800
Edmonton	627,200	120,960	313,600	60,480
Pembina	1,260,000	252,000	630,000	126,000
Whitecourt	84,000	16,800	42,000	8,400
Halcourt	168,000	84,000	84,000	42,000
Total—Alberta Plains (Edmonton Formation)	4,916,800	1,079,600	2,458,400	539,800

No estimate of the future of any operations within these areas, however, can be deduced from the above figures as these relate to the area as a whole rather than to any particular properties or section of the area.

This observation has particular relevance to the operations presently being conducted in the Red Deer Valley of the Drumheller area, commonly referred to as the Drumheller coal field. The estimate figures for this area, which are based on seams having a minimum thickness of 3 feet lying beneath a maximum depth of cover of 1,000 feet, indicate a substantial tonnage of probable mineable coal. On the other hand, the Commission has received engineering advice to the effect that the Drumheller coal field has now reached its maximum capacity and that, with few exceptions, the life of the mines at the present level of annual production is limited to twenty to thirty years. The essential feature of this local situation is the "bad land" topography of this section of the Red Deer Valley. The Edmonton formation in this area has a thickness of 1,050 feet and contains five workable seams which, in ascending order, are Nos. 1, 2, 5, 7 and 11. Most of the operations in the area are confined to seams Nos. 1 and 2. Seam No. 1 ranges in thickness from 3.3 feet to 7 feet and averages 5 feet. The seam lies about 130 feet above the base of the formation. Seam No. 2 ranges in thickness from 3 feet to 6.5 feet and averages 4.5 feet. It lies 30 feet above No. 1 seam. Red Deer Valley has a depth ranging from 300 to 500 feet in a width of 3 miles, beyond which limits the topography rises to considerably higher elevations. It is evident, therefore, that where No. 1 seam outcrops at valley level, the maximum depth of mining, which engineering advice has set at about 600 feet, will be reached when mining operations have proceeded about 1.5 miles from the point of entry. Where the Red Deer has cut its channel below the seam outcrop, the cover is generally correspondingly less, thus permitting more extended workings. On the assumption that 600 feet constitutes a maximum cover and that seams Nos. 5, 7 and 11 are not commercial in the Red Deer Valley, it would seem that the reserve situation in respect to many of the mines is assuming primary importance. It is possible that the operators in this area will find it feasible to continue operations beyond the point at which 600 feet of cover is reached. Failing that, the alternative will be for them to open up new operations in the adjacent uplands or in other areas. This may involve higher operational costs and the loss of convenient railway facilities.

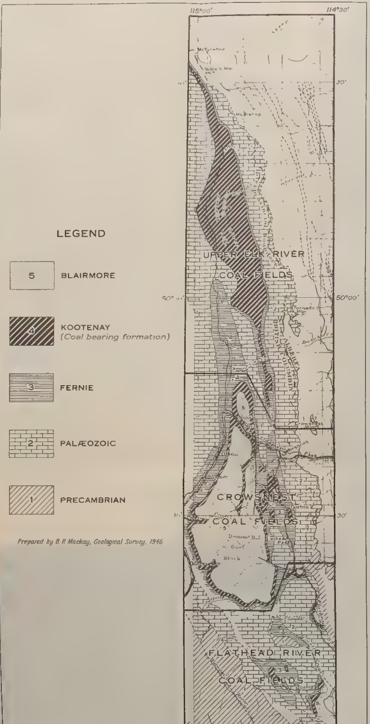
SUMMARY

It is clear from the foregoing that Alberta has very extensive reserves of bituminous and sub-bituminous coals. The most valuable reserves from the point of view of both quality and quantity are concentrated in the Foothills belts, notably in the Inner Foothills belt. Of the Plains regions, the Edmonton formation is the more important and represents an extensive reserve of sub-bituminous coal. Markets, rather than reserves, are the fundamental problem of the Alberta coal mining industry.

PROVINCE OF BRITISH COLUMBIA

Coal deposits occur in widely distributed areas throughout the Province of British Columbia. Reference to Map 10 also shows that the deposits are generally confined to small areas. The majority of them, it will be noted, occur at great distances from the main population and industrial centres, important deposits in the northern part of the Province being without railway facilities.

MAP II



COAL FIELDS OF SOUTHEASTERN BRITISH COLUMBIA

SCALE OF MILES

10 0 10 20 30

The coal deposits of the Province are of the same three geological ages as the coals of Alberta, namely, Lower Cretaceous (some of which may be Jurassic), Upper Cretaceous and Tertiary. The most important deposits in the Province in respect both to present and potential development are those of Lower Cretaceous age. These include the deposits of the Crowsnest coal fields of southeastern British Columbia, the Peace River coal field of northeastern British Columbia, the Telkwa and Groundhog fields further to the west, and a number of small isolated deposits in northwestern British Columbia near the Alaska boundary. The only substantial production from these coal fields comes from the Crowsnest district. The coal mined in this district is of medium volatile bituminous rank. The coals of the other areas show wide range in rank. Those of the Peace River district are largely low volatile bituminous; those of the Telkwa district are mainly of high volatile bituminous rank; those of the Groundhog area are mainly low volatile coals; and the deposits of northwestern British Columbia are mostly lignitic coals.

The coal deposits of Upper Cretaceous age are restricted to Vancouver Island and Graham Island to the northwest. The coals of Vancouver Island are all of high volatile "A" bituminous rank. Those of Graham Island range from high volatile "A" bituminous rank to anthracite.

The Tertiary deposits are widely scattered throughout British Columbia and, with few exceptions, are of little economic significance. The locations of these are shown on the Map. In central and northern British Columbia, they consist of deposits of lignitic material which is either too unconsolidated or too thin to be mineable. The only deposit of any significance in this group occurs on Bowron River where three commercial seams of bituminous coal are believed to underlie an area of approximately 10 square miles. In southern British Columbia the Tertiary deposits occur in much larger basins and are more mature. These include the deposits at Hat Creek, Princeton, Merritt and Tulameen. The coals in these areas range in rank from lignite to bituminous.

In succeeding pages the important coal deposits of British Columbia will be discussed by districts.

Southeastern British Columbia

The coal fields of southeastern British Columbia occur near the Alberta border and extend for a distance of over 100 miles northward from the International Boundary. As will be seen from Map 11 these coal fields are divided structurally into three basins each containing a number of coal fields, the Flathead River coal fields in the south, the Crowsnest fields in the centre and the Upper Elk River coal fields in the north. Mining operations are at present confined to the Crowsnest basin, which is the largest producing coal area in British Columbia. Production is centred in two collieries of the Crow's Nest Pass Coal Company Limited located on the southern transcontinental line of the Canadian Pacific Railway near Fernie and at Michel. Until recently, mining operations were also conducted at Corbin, operations having commenced in that area in 1908.

The coals of southeastern British Columbia are of the same Lower Cretaceous geological age as those of the Inner Foothills belt of Alberta and formed part of the same deposit. It will be recalled from previous discussion of Alberta coal reserves, that the main development of the Kootenay coals of the Inner Foothills belt of Alberta occurred in this southeastern section of British Columbia.

At present the general structural trough in which occur the coal fields of southeastern British Columbia is separated from the Inner Foothills belt of Alberta by a four-mile wide belt of limestone that forms the front belt of the

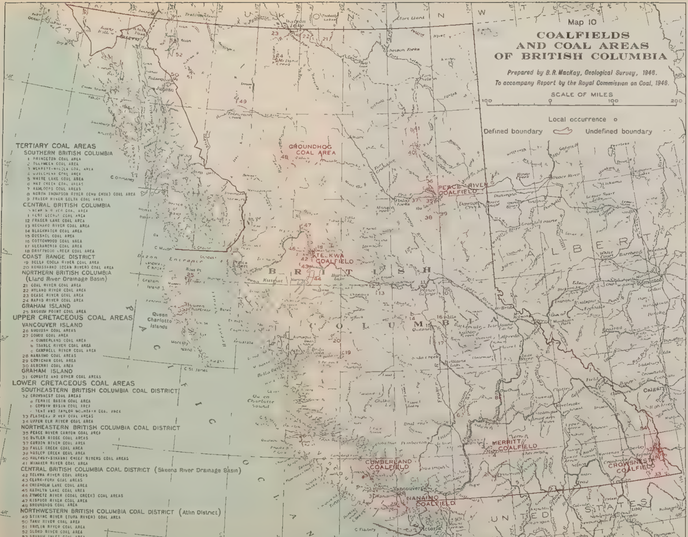
Rocky Mountains. This separation took place during the formation of the mountains, at which time the basin of deposition was cut by a major south-westerly dipping fault. Along this fault the portion of the basin lying to the west, with its underlying limestone beds, was thrust eastward and upward.

Folding and faulting within the basin in the British Columbia area has resulted in dividing the main structural trough in which the coal had been formed, into the three individual coal basins previously noted. As might be expected the rank of the coal in each of these basins is more or less similar and they are mainly of medium volatile bituminous rank. There is, however, a wide range in the characteristics of the coals. Some of the seams have a very low ash content, whereas others, notably the thick seams at Corbin, have a very high ash content. As in the instance of the coals of the Inner Foothills belt of Alberta, the coals are friable in areas where they have been subjected to faulting.

The central Crowsnest deposits are the most important in the area. As will be seen from Map 11 this area comprises the Fernie coal basin on the west and a group of smaller coal fields on the east, of which the Corbin area is the most important. The Fernie coal basin is the most important coal basin in British Columbia. It is a pear-shaped basin with its narrow portion to the north. It has a length of about 34 miles and a maximum width in the vicinity of Fernie of 12 miles, and covers an area of approximately 230 square miles all of which is underlain by coal. Sections measured at different areas in this basin have shown the presence of up to 23 seams of coal, 18 of which are over 3 feet in thickness. They have an aggregate thickness ranging from 100 to 172 feet. A vast proportion of this coal lies in the central portion of the basin beneath a great thickness of barren sandstones which forms the local plateau in this mountainous area. The coal measures are in turn underlain by a great thickness of soft marine shales. These have been deeply eroded by Elk River which runs along the west side of the basin. Thus the coal seams outcrop high up along the east side of the valley and are relatively inaccessible, except where tributary streams of Elk River have cut deep notches through the rim of the coal basin. Erosion in these fields has resulted in providing access to the seams at the valley level, thus not only facilitating mining operations but providing conditions for railway communication with the site of operations. The most favourable points of access from this point of view are found in the Michel Creek valley which is traversed by the Canadian Pacific Railway. The west side of the coal basin, along which the Canadian Pacific Railway line continues, provides only two further favourable conditions, namely, in the valleys of Coal Creek and Morrissey.

Mining experience has already established the fact that recovery is impractical in this locality much below a maximum cover of 2,500 feet, mining operations at that depth having been terminated because of the occurrence of "bumps". Except where Michel Creek has cut a wide valley across the basin to provide easy access to practically all of the seams, the available reserves of this field must be limited to the rim of the basin where the coal seams outcrop and lie within the limit of 2,500 feet of cover. Accordingly the estimate prepared for the Commission is confined to the coal lying within these limited areas. The dip of the seams varies according to location within the basin, and range from five to a maximum of 60 degrees. In the Michel area the dip is very moderate, whereas in the Fernie area the seams are inclined at about 30 degrees.

In the estimate prepared for the Commission which appears in Table 16, Appendix A, the reserves of mineable coal in this area are given as approximately 6,328,000,000 tons of probable coal and 1,860,000,000 tons of possible coal. It


Map 10
COALFIELDS AND COAL AREAS OF BRITISH COLUMBIA
Prepared by B.R. MacKay, Geological Survey, 1946.
To accompany Report by the Royal Commission on Coal, 1946.
SCALE OF MILES
100 0 100 200
Local occurrence o
Defined boundary
Undefined boundary
TERTIARY COAL AREAS
SOUTHERN BRITISH COLUMBIA
1 PRINCETON COAL AREA
2 TULAMEEN COAL AREA
3 MERRITT-NICOLA COAL AREA
4 QUILCHENA COAL AREA
5 WHITE LAKE COAL AREA
6 HAT CREEK COAL AREAS
7 KAMLOOPS COAL AREAS
8 NORTH THOMPSON RIVER (CHU CHUA) COAL AREA
9 FRASER RIVER DELTA COAL AREA
CENTRAL BRITISH COLUMBIA
12 FRASER LAKE COAL AREA
13 NECHAKO RIVER COAL AREA
14 BLACKWATER COAL AREA
15 QUESNEL COAL AREA
16 COTTONWOOD COAL AREA
17 ALEXANDRIA COAL AREA
18 DRIFTWOOD CREEK COAL AREA
COAST RANGE DISTRICT
19 BELLA COOLA RIVER COAL AREA
20 KOHASGANKO (DEAN RIVER) COAL AREA
NORTHERN BRITISH COLUMBIA
(Liard River Drainage Basin)
21 COAL RIVER COAL AREA
22 HYLAND RIVER COAL AREA
23 DEASE RIVER COAL AREA
24 RAPID RIVER COAL AREA
GRAHAM ISLAND
25 SKONUN POINT COAL AREA
UPPER CRETACEOUS COAL AREAS
VANCOUVER ISLAND
26 SUQUASH COAL AREAS
27 COMOX COAL AREA
a CUMBERLAND COAL AREA
b TSABLE RIVER COAL AREA
c CAMPBELL RIVER COAL AREA
28 NANAIMO COAL AREAS
29 COWICHAN COAL AREA
30 ALBERNI COAL AREA
GRAHAM ISLAND
31 COWGITZ AND OTHER COAL AREAS
LOWER CRETACEOUS COAL AREAS
SOUTHEASTERN BRITISH COLUMBIA COAL DISTRICT
32 CROWSNEST COAL AREAS
a FERNIE BASIN COAL AREA
b CORBIN BASIN COAL AREA
33 FLATHEAD RIVER COAL AREAS
34 UPPER ELK RIVER COAL AREA
NORTHEASTERN BRITISH COLUMBIA COAL DISTRICT
35 PEACE RIVER CANYON COAL AREA
36 BUTLER RIDGE COAL AREAS
37 CARBON RIVER COAL AREA
38 FALLS CREEK COAL AREA
39 HASLER CREEK COAL AREA
40 HALFWAY-SIKANNI CHIEF RIVERS COAL AREAS
41 MINAKER RIVER COAL AREA
CENTRAL BRITISH COLUMBIA COAL DISTRICT (Skeena River Drainage Basin)
42 TELKWA RIVER COAL AREAS
43 CLARK-FORK COAL AREAS
44 CHISHOLM LAKE COAL AREA
45 KATHLYN LAKE COAL AREA
46 ZYMOETZ RIVER (COAL CREEK) COAL AREAS
47 KISPIOX RIVER COAL AREA
48 GROUNDHOG COAL AREA
NORTHWESTERN BRITISH COLUMBIA COAL DISTRICT (Atlin District)
49 STIKINE RIVER (TUYA RIVER) COAL AREA
50 TAKU RIVER COAL AREA
51 INKLIN RIVER COAL AREA
52 SLOKO RIVER COAL AREA
53 GRAHAM INLET COAL AREA
GROUNDHOG COAL AREA
PEACE RIVER COALFIELD
TELKWA COALFIELD
MERRITT COALFIELD
CUMBERLAND COALFIELD
NANAIMO COALFIELD
CROWSNEST COALFIELD
BRITISH COLUMBIA
ALBERTA
UNITED STATES
PACIFIC OCEAN
YUKON
N.W.T.
Queen Charlotte Islands
Vancouver
Victoria
Calgary
Edmonton
Prince Rupert
Juneau

is readily apparent, therefore, that this field has almost unlimited resources. The essential problem is accessibility and operational hazards due to accumulated mountain pressures. The abundance of the reserves in this area was illustrated to the Commission by the submission of the operating company in the field where, in respect to the two limited areas aggregating about 15 square miles, which form only a small part of their holdings, it was estimated that their reserves were as follows:

Assured	Probable	Possible
36,580,000 tons	70,490,000 tons	1,049,000,000 tons

It will be noted from the estimate covering the Crowsnest coal fields that the Corbin field has a very considerable reserve. This reserve is concentrated in Coal Mountain that has an area of less than 3 square miles, and consists of coal seams of remarkable thickness that have been subjected to intense folding, crushing and faulting. The estimate of 81,000,000 tons is based on a detailed investigation of this deposit by the Geological Survey in 1930. This estimate includes mineable rather than recoverable coal, but it is noted that operations were discontinued in 1933, and spur-line trackage subsequently torn up when less than 2,500,000 tons had been mined. The Commission is advised that although a large proportion of the underground reserves cannot be recovered, the Corbin field contains a large tonnage of readily mineable coal, a considerable portion of which might be recovered by open-cut operations.

The next most important group of coal fields in southeastern British Columbia are contained in the Upper Elk River basin which lies to the north of the Fernie basin. This basin has a similar north-south trend and extends for a length of about 50 miles and has a maximum width of about 10 miles. The area underlain by coal is estimated at over 125 square miles.

In this basin there are the same series of coal seams as occur in the Fernie basin but the deposits have been greatly eroded so that the reserves of the basin have been correspondingly reduced. Unlike the Crowsnest, the coal deposits of this Elk River basin are not characterized by a great depth of cover. Consequently the coal is more readily accessible from a point of view of mining operations. Assuming that mining operations can be conducted at 2,500 feet, much of the coal can be recovered. Development, however, is dependent on the construction of at least 35 miles of railroad, probably along the Elk River, from the nearest point of the Canadian Pacific Railway. The Commission is advised that the reserves of the area are most extensive, a reasonable approximation being 3,533,000,000 tons of probable coal and 2,458,000,000 tons of possible coal. A more detailed estimate appears in Table 16, Appendix A.

The remaining coal fields of southeastern British Columbia lie in the Flathead drainage basin and consist of a group of four small isolated deposits separated by barren rocks, the result of folding. Small mining operations have been carried on intermittently at some of these areas, but have since been terminated due to relative inaccessibility to markets. No railway communications exist in this area.

As will be seen from the estimate prepared for the Commission, the reserves of these coal fields are relatively small. In view of the more readily accessible reserves in the Crowsnest coal field, it is difficult to foresee their development beyond small scale mining for local purposes.

Northeastern British Columbia

The coal deposits of northeastern British Columbia are all of Lower Cretaceous age and occur in the Gething formation which is a northwestern extension of the Luscar formation of the Inner Foothills belt of Alberta. These deposits occur in the following seven areas—the Peace River Canyon, Butler Ridge, Carbon River, Falls Creek, Hasler Creek, Halfway-Sikanni Chief Rivers and Minaker River areas. The deposits of the Butler Ridge, Halfway-Sikanni Chief Rivers and Minaker River areas are of recent discovery arising out of geological mapping accompanying the construction of the Alaska Highway and little is known of their extent. The Carbon River deposit and its southeasterly extension at Falls Creek have been known for some time but no development work has taken place. Small scale operations commenced recently in the Hasler Creek area but generally mining has been confined to the Peace River Canyon area. In this area mining has taken place on the east and west sides of Portage Mountain which forms the southern extension of Butler Ridge. Production from these mines has been for local use mainly at Fort St. John about 50 miles to the east, but with the construction of the Alaska Highway, the local market has expanded to include Dawson Creek which is largely served from the Hasler Creek area.

The best exposure of the coal measures in this region occurs in the Peace River Canyon area, where the seams outcrop on the nose and both sides of an anticlinal fold that plunges to the south. The formation in this area is 1,400 feet in thickness and contains eight coal seams having average thicknesses ranging from 3 feet 5 inches to 5 feet 6 inches. The coal mined is of low volatile bituminous rank, and is of high grade.

It is apparent from the Commission estimate (see Table 17, Appendix A), that these northeastern British Columbia deposits contain large tonnages of good coal which will be available as this part of Canada develops.

Central British Columbia

The coal deposits of central British Columbia include the Lower Cretaceous deposits occurring in the Skeena River drainage basin with their main developments located in the Telkwa and Groundhog areas, and other Tertiary deposits occurring in the upper Fraser River basin centering in the Cariboo district. As previously noted the Tertiary deposits consist of numerous small isolated basin deposits, the majority of which are either too thin or inferior in quality, or of too small areal extent to warrant development under existing conditions. They consist largely of matted leaves and carbonized logs in thin seams interstratified through hundreds of feet of clays and sandstones. The deposit in the Bowron River area is an exception to this. This deposit which occurs on Bowron River in the Cariboo district some 30 miles east of Prince George, and some 15 miles west of the transcontinental line of the Canadian National Railways, contains three commercial coal seams measuring 4 feet, 7.5 feet and 9 feet, which are thought to underlie an area of about 10 square miles. The coal has been classified by the Provincial Government as bituminous coal.

The Lower Cretaceous coal deposits occur in a number of isolated basins some of which doubtless represent remnants of much more extensive deposits. Most of these are small deposits occurring in the Bulkley River area. The most important is the Telkwa deposit which has been under development for a number of years. The most extensive deposit of these Lower Cretaceous coals, however, occurs in the Groundhog area. Geographically, deposits of the central part of British Columbia are separated from those of northeastern British Columbia by a 180-mile belt of territory underlain by older rocks and the correlation of the coals of the two areas has not been established. Fossil evidence indicates a correlation with the Kootenay deposits of the Crowsnest districts of British Columbia and Alberta rather than with the Luscar formation of northwestern Alberta.

The Groundhog deposit lies in relatively unexplored rugged mountainous territory at the headwaters of the Skeena River. The nearest railway centre is some 150 miles to the south at Hazelton on the Canadian National Railways line to Prince Rupert. About 170 square miles of the Groundhog area are underlain by coal-bearing formations but the extent of the coal deposits is not known. Extensive prospecting of the Skeena River along its tributary streams has shown that the measures contain thirteen seams distributed through a stratigraphic interval of 1,240 feet, four of which are of commercial thickness. These seams measure 12 feet, 3 feet, 4 feet and 4 feet. The coal is largely low volatile bituminous and anthracite. The coal measures outside of this limited area are badly folded and faulted, and much of the area is inaccessible due to the mountainous terrain. A conservative estimate of the mineable reserves of the Groundhog area gives a total of nearly 900,000,000 tons of probable and possible coal. The possibilities of development in the area are conditioned by inaccessibility to markets.

In contrast the reserves of the Bulkley River coal deposits are more limited where they are more accessible, most of them being located close to the Canadian National Railways main line to Prince Rupert. The most important of these deposits lies in the Telkwa basin. This basin has an area of about 7 square miles underlain by coal-bearing rocks having a thickness of from 350 to 500 feet, and contain five seams, three of which are more than 3 feet in thickness. Over most of this area the coal measures are concealed by a heavy coat of alluvium and glacial drift, and the outcrops are confined largely to the immediate vicinity of Telkwa River and its tributary, Goat Creek. At these localities the coal seams generally have moderate inclination but in other places are folded or terminated by faults and cut by volcanic rocks. This folding and faulting and subsequent erosion has divided the Telkwa deposit into a number of small localized coal deposits, the extent of which is concealed by the thick cover of alluvium and glacial drift. This has presented serious problems in respect to mining and prevents any accurate assessment of the reserves without a programme of systematic drilling.

The coal mined in the Telkwa field is high grade high volatile "A" bituminous coal having a calorific value of 13,160 B.t.u./lb. The coal is of particularly hard structure.

The only other deposit in the Bulkley River area where mining has taken place is at Kathlyn Lake. The coal in this area is of anthracitic rank but only two seams are of commercial thickness and only limited mining is possible due to the folded, faulted and crushed conditions of the coal measures. Detailed estimates of these areas appear in Table 18, Appendix A.

Northern British Columbia

The coal deposits of northern British Columbia are of Lower Cretaceous and Tertiary ages. The Cretaceous coals are of high volatile "C" rank and the Tertiary coals are lignite. The location of these deposits is apparent from Map 10. The full extent of these deposits is not known but due to the low rank of the coal and their inaccessibility their significance is purely local. An estimate of the reserves of the area appears in Table 19, Appendix A.

South Central British Columbia

The coal deposits of south central British Columbia are all of Tertiary age and occur in numerous relatively small detached basins. They include the deposits in the Princeton, Tulameen, Merritt-Nicola, Quilchena, White Lake, Hat Creek, Kamloops and Chu Chua areas. Most of the deposits are of lignitic rank and apart from the Hat Creek area have little significance. At Hat Creek the deposit is of exceptional thickness. The deposit, however, is very impure and consists of interbedded lignite and clay. It outcrops at creek level but

development has shown it to be highly folded, faulted and covered by volcanic rocks. It is possible that a large tonnage could be recovered by stripping operations.

The important deposits in this region occur in the Nicola Valley, Princeton and White Lake areas. In the former, mining operations have been carried on intermittently for the past 40 years, the principal operations being in the Diamond Vale section of the area. These operations have shown the existence of six coal seams of commercial thickness. About 38 square miles of the Nicola Valley are underlain by coal but most of this area lies in the centre of the basin beneath a great thickness of younger sediments and alluvium. The coal seams outcrop along the rim of this basin and dip toward its centre at angles up to 26 degrees. The coal ranks as high volatile "B" bituminous but is of low grade due to the presence of impurities interbedded in the coal seams and requires the installation of expensive washing and cleaning equipment in order to prepare the coal for market.

Small scale mining operations have been carried on in the Princeton field some 30 miles farther to the south for the past four years. At the present time only one company is operating in the area. The coals in this area range from lignite to sub-bituminous "A" and "B." This Princeton field consists of a basin deposit having a length of 14 miles and a width of from 3 to 6 miles and covering an area of approximately 50 square miles. The coal measures consist of sandstones and shales and contain at least four seams of commercial thickness, most of which lie within 300 feet of the surface. These measures are irregularly folded and cut by faults. Following the deposition of these coal measures they were overlain by flows of volcanic rock, remnants of which still conceal the coal measures along the rims of the basin, except where the flows have been cut through by the main streams. In many places these streams also cut their channels into the underlying coal measures and removed extensive areas of the uppermost coal seams. Over much of the basin a later deposit of glacial drift or alluvium ranging up to 25 feet in thickness conceals the coal measures, with the result that the outcrops of these measures are few and largely restricted to the channels of the main streams. These factors have been serious handicaps to geological investigations and mining development. Most of the known occurrences of coal within this basin have been prospected and the readily available coal of these locations has been mined. Further development of these deposits is dependent on new discoveries which will arise out of systematic drilling along the borders of the basin.

The White Lake field is a small basin deposit occurring on the western side of Okanagan Valley, 6 miles west of Okanagan Falls. The basin has an area of about 6 square miles and the measures contain at least two seams of bituminous coal of mineable thickness. Small scale mining for local consumption has been conducted intermittently in this area for the past 30 years.

Details of the reserves of these areas appear in Table 20, Appendix A. The reserves of the area as a whole are placed at approximately 279,000,000 tons of probable coal and about 140,000,000 tons of possible coal, about half of which is recoverable coal.

Vancouver Island

The coal deposits of Vancouver Island are all of Upper Cretaceous age and occur in the lower part of the Nanaimo series which has an average thickness of about 7,000 feet. These measures occur in five principal areas namely, Comox, Nanaimo, Suquash, Cowichan and Alberni. In the latter three areas the deposits are not commercial, the coal seams being either too thin or too dirty to permit profitable mining. There remains for consideration the Nanaimo and Comox areas. Mining operations have been conducted in these two areas for a long

period. The main centres are Nanaimo in the first area and Cumberland in the Comox area. These lie respectively about 60 to 110 miles north of Victoria. The coal mined is of high volatile "A" bituminous rank.

The coal deposits of these two areas do not occur in the same geological horizon. Those of the Nanaimo area occur in the East Wellington and Newcastle formations in the lower part of the Nanaimo series, and are considerably older than those of the Comox area, which lie in the Comox formation, the equivalent of the sediment immediately overlying the Newcastle formation of the Nanaimo area. In the Comox area the coal-bearing formations of the Nanaimo area are missing, and the Comox formation rests directly on pre-Upper Cretaceous volcanic rocks. In both of these areas the coal-forming vegetation accumulated in lagoons and swamps along the sea coast, the greater part of the vegetation having been rafted into these areas. The resulting coal deposits are neither extensive nor uniform in thickness, but consist of irregular lense-like deposits of coal separated by deposits of clay interspersed with coal and barren areas. Each of these deposits in turn is characterized by clay partings and frequent occurrences of barren areas. In the Comox district these barren areas are extensive and are the result mainly of irregularities in the underlying volcanic rocks, which in places formed islands projecting above the swamps. In both areas smaller irregularities in the seam were caused by the erosion of streams which occurred during the formation of the bed rock. Folding and faulting has resulted in further variations in the thickness and attitude of the seams. Due to a thick covering of more recent sediments and of glacial drift, systematic drilling is necessary to locate and determine the extent of each of these deposits, and mining operations are necessarily expensive due to the combination of geological factors referred to above.

The coal measures in the Nanaimo basin underlie an area of approximately 100 square miles extending from the north shore of Departure Bay southward to include Gulf Island. However, only about 12 square miles in all is known to be underlain by coal seams having the minimum thickness required for mining operations in Vancouver Island. These occur within areas extending 10 miles south from Departure Bay to Nanaimo River, and from Extension Basin eastward to the submarine area of Northumberland Channel. There are four commercial coal seams in the area. Two of these having average thicknesses of 2 feet and 4 to 7 feet, occur at or near the top of the East Wellington formation about 700 feet above the base of the Nanaimo series. These seams outcrop in the western part of the Nanaimo area where they occur on the rims of shallow structural basins or in the flanks of anticlinal folds. They have been extensively mined in the vicinity of Extension and Northfield. The other two seams, having average thicknesses of 5 feet and 3 to 6 feet, occur in the Newcastle formation which lies 800 to 1,000 feet above the East Wellington formation. These seams outcrop in the eastern part of the field from the northern end of Newcastle Island southward along the coast line through Nanaimo to beyond South Wellington. They have been extensively mined at Nanaimo where the submarine workings extend beneath Nanaimo harbour. Limited work has been carried out at Nanaimo in respect to the lower seams of the East Wellington formation which in this area have a correspondingly gentle easterly dip.

Mining has been carried on in the Nanaimo field for more than fifty years and most of the known available coal has been recovered. Recent investigations of the Geological Survey indicate that the reserves in the area are only sufficient to allow operations to continue at the current level of production for from ten to fifteen years, after which production will be limited to the output of very small local mines. This is confirmed by the estimate of reserves submitted by Canadian Collieries (Dunsmuir) Limited, the principal operating company on Vancouver Island.

An analysis of the coal mined in this area appears below:

		(As received basis)
Moisture	Per cent	3.7
Ash	Per cent	10.7
Volatile Matter	Per cent	36.5
Fixed Carbon	Per cent	49.1
Sulphur	Per cent	0.4
Calorific Value	B.t.u./lb.	12,510
F.P.A.	°F	2,375

The coal deposits of the Comox area are distributed over a territory extending from T'Sable River northwest to Campbell River, a distance of about 45 miles, and inland from the coast for distances ranging from 2 to 13 miles. Less than a quarter of this area is believed to contain commercial coal which occurs in the following districts, the Cumberland, T'Sable River, Dove Creek-Brown's River, Tsolum River, Quinsam and Campbell River districts. These coal areas differ widely in size and in the extent of their reserves as will be seen from the Commission estimate. (See Table 21, Appendix A). They are separated from each other by extensive intervals of barren rock ranging from 2 to 7 miles.

Mining to date has been largely confined to the Cumberland area where ten or more seams occur, three of which have been workable. These workable seams range in thickness from 2.5 feet to 10 feet and vary greatly in quality. The mining centres are at Cumberland, Bevan and Puntledge. The seams in this area have been extensively worked and all the easily available coal has been mined. Future production will largely come from seams at depths of 1,000 feet or more.

The T'Sable River coal area lies to the southeast of the Cumberland coal field and is separated from it by five miles of non-coalbearing sediment. The area is an irregularly shaped basin-like deposit covering about 12 square miles. It extends from the T'Sable River northwest for a distance of four miles and has a width ranging from less than a mile to a maximum of four miles. A large amount of prospecting has been carried out in the area and has shown the coal to occur in at least five principal horizons each of which may consist of one or more seams. Three of these seams are workable having average thicknesses ranging from over 2.5 feet to over 11 feet. The coal measures lie with a general northeasterly dip averaging about 7 degrees. There has been some folding and faulting and the effect of this disturbance superimposed on initial irregularities of the seams arising out of the uneven topography on which they were laid down, has caused the coal to occur in more or less distinct basins. As will be seen from the estimate quoted above this area constitutes one of the most important proven coal reserves of the Comox area. Mining development work is now being undertaken at T'Sable River with a view to counterbalancing any decreases in production from the Nanaimo area.

The Dove Creek-Brown's River coal area embraces about two square miles, the centre of which lies about nine miles northwest of Comox. Coal occurs in the area in several seams which range in thickness from one to five feet. Some of them are well exposed on Brown's River and Dove Creek, and they have been intercepted by numerous bore-holes. In places the coal deposits have been rendered uncommercial by intrusions of volcanic rock. The Commission is advised that the company estimate of the reserves of this area is probably conservative.

Very little is known of the three remaining coal districts of the Comox region, namely, the Tsolum, Quinsam and Campbell River districts, which lie in large unexplored territory to the north at the headwaters of Tsolum River and on Quinsam River. Coal seams of commercial thickness outcrop along these rivers or their tributary streams and further prospecting has been carried on by diamond drilling. Access to these areas is available through the railway communications established by a number of logging and lumbering companies. It is possible that the company's estimate of reserves for these areas given above, may prove conservative.

Graham Island

Small coal deposits of both Upper Cretaceous and Tertiary ages also occur on Graham Island which is the most northerly of the Queen Charlotte Islands. The most important of these are those of Upper Cretaceous age which are found in five small basins in the southern part of the Island. The coal of these areas ranks generally as low volatile bituminous, some anthracite occurring in sections of the deposit which have been affected by volcanic intrusions. The coal seams of these deposits are seldom more than three feet in thickness and are badly folded and faulted. Mining has been carried on spasmodically for local consumption, the coal mined being generally of low grade due to high ash content. The Tertiary deposits occur along the northern coast of the Island, principally at Skonun Point. Up to 15 seams have been reported but they are generally thin and the quality of the coal is low grade lignite. The Commission is advised that the reserves of Graham Island have only limited significance due to difficulties in recovery arising out of the disturbance of the coal measures and the low grade of the coal. An estimate of the reserves appears on Table 22, Appendix A.

THE YUKON AND NORTHWEST TERRITORIES

The construction of the Alaska Highway, mining developments in the Yukon and in the Yellowknife district of the Great Slave Lake region of the Northwest Territories, and the increasing importance of the Polar areas in respect to aviation in recent years have directed attention to the possibilities of securing local supplies of coal in the Yukon and Northwest Territories, much of which is devoid of wood. In particular, the construction of the Alaska Highway through the southwestern section of the Yukon has brought a demand for coal in that area to supply wayside stations and the larger centres of population. The large-scale development in Yellowknife district has also created a local demand for both domestic and industrial fuel in the Great Slave Lake region. Trans-Polar and inter-continental aviation is demanding the establishment of meteorological stations in the Arctic Islands of the Northwest Territories. The possibilities of securing local supplies of coal will be a determining factor in the location of these establishments. Government stations at Pond Inlet on Baffin Island and at Aklavik on the Mackenzie River are supplied from local deposits of coal.

Comparatively little is known of the coal resources of the Yukon and Northwest Territories beyond where actual mining operations have taken place or where outcrops of coal seams and "float-coal" have been observed.

With the exception of the vicinity of the Whitehorse-Dawson road, exploration in the Yukon has been largely confined to the major stream courses whereas, in the Arctic Islands, exploration has been mainly restricted to the areas in the immediate vicinity of the coast lines.

The Yukon

The coal deposits of the Yukon are extensive and widely distributed. These deposits are largely of Lower Cretaceous and Tertiary ages, those of the earlier Cretaceous age being the most important. These are largely confined

to the drainage basin of Lewes River and have been mined principally at Tantalus in the Carmacks district. Further deposits occur to the south of this district, in the Laberge, Aishihik and Whitehorse areas, and to the north in the Arctic coast area. A small mine is in operation in the Arctic area at Moose River as a source of supply for the Government station at Aklavik. The coals of these areas are largely of high and medium volatile bituminous rank but range from lignites to low volatile bituminous.

The coals of Tertiary age, which are all of lignitic rank, have been extensively mined in the Dawson district, but are known to occur in mineable seams in the Ogilvie, Kluane, Kaskawulsh, Dezadeash and Watson Lakes districts to the south and southeast and in the Bonnet Plume district to the northeast.

A preliminary estimate of the coal reserves of the Yukon Territory appears in Table 23, Appendix A, and gives a total of nearly 2,000,000,000 tons of probable and possible mineable coal. The figures are of necessity approximations but they are sufficient to indicate that, with few exceptions, the reserves are sufficient to meet the increasing demand which may be expected with the development of the Yukon.

The Northwest Territories

The coal deposits of the Northwest Territories are of three geological ages, Tertiary, Lower Cretaceous and Carboniferous, and the coals range in rank from lignite to bituminous. Very little is known of the extent of the deposits due largely to the unexplored nature of this part of Canada.

The Tertiary deposits are found at Fort Norman on Mackenzie River, in the centre of Banks Island and at numerous points along the west and northeast coasts of Ellesmere Island, on the west coast of Bylot Island and at Pond Inlet at the mouth of Salmon River on the north coast of Baffin Island. Mining has been confined to a small operation at Pond Inlet, where the coal is of good grade lignitic or sub-bituminous rank.

The known deposits of Lower Cretaceous age are confined to five localities in the Mackenzie River Basin, namely, Liard River, Great Bear Lake, the west channel of Mackenzie River, the west shore of Franklin Bay and the adjacent Langton Bay. No mining has been carried on in these areas. Analysis of samples of the coals indicates that they are of lignitic rank.

Coal of Carboniferous age, largely in the form of "float-coal", has been reported from more than twenty-eight localities along the coast lines of the central Arctic Islands, extending from Prince Patrick Island on the west to Graham Island on the east and from the northeast coast of Banks Island on the south to the northern end of Axel Heiberg Island. These localities occur over an area measuring 500 miles in length and 250 miles in breadth. Bituminous seams up to 25 feet in thickness have been reported by explorers in some of these localities and have served as sources of fuel supply for various expeditions. The existence of coal deposits in these Arctic Islands is of strategic importance in respect to Arctic exploration and the development of inter-continental air communications. A preliminary estimate of the reserves of the Northwest Territories appears in Table 24, Appendix A. This estimate places the reserves at about 2,500,000,000 tons of probable and possible mineable coal.

OWNERSHIP OF COAL AND MINING RIGHTS

Ownership of Canada's coal resources is divided between the Dominion Government, the Provincial Governments, and private interests. Ownership of coal rights by the Dominion Government is confined to the Yukon and Northwest Territories, two areas in the Crowsnest in southeastern British Columbia and the National Parks. Some of the land grants in the Yukon and Northwest Territories carry coal rights. Where the rights remain with the Crown, access is provided on the basis of rental of $1.00 per acre and a royalty of 5 cents a short

ton. With few exceptions, for example, Indian Reserves, where coal is the property of the Indians, coal rights in respect to the remaining parts of Canada fall under provincial jurisdiction. The distribution of ownership of coal rights varies according to provinces, one essential feature being that the Maritime Provinces of Nova Scotia and New Brunswick have clear title to their coal resources, whereas the Western Provinces share ownership with private interests.

Nova Scotia and New Brunswick held the coal rights of their respective provinces at the time of Confederation, and none of the coal has been alienated from the Crown in the right of the provinces since 1867. In the Western Provinces coal rights over substantial areas are held by the Hudson's Bay Company, the Canadian Pacific Railway Company, and a number of corporate and individual interests. This alienation of the coal resources from the Crown is derived from a long period of history in which, with the exception of British Columbia, the provincial governments have played a very minor role until 1930 when ownership of the natural resources was finally transferred from the Dominion Government to the provinces.

British Columbia at the time of its entry into the Union had jurisdiction over its natural resources. Subsequent to 1870 British Columbia placed at the disposal of the Dominion Government large land areas, commonly referred to as the "railway belt" and "Peace River block," in connection with the construction of the Canadian Pacific Railway Company's transcontinental line to the Pacific Coast and the development of the Peace River district. The coal mining rights of extensive areas in these two districts were alienated from the Crown prior to 1930, at which time the resources of these areas which had not been alienated were returned to the Province. A further tract of land comprising some 3,000 square miles in the southeasterly portion of Vancouver Island was placed under Dominion control by 47 Victoria, Chapter 14, Statutes of British Columbia, to aid in the construction of the Esquimalt and Nanaimo Railway. The lands in this tract, including coal rights, were transferred by the Dominion to the Railway Company in 1887 and 1905. Prior to 1899 coal rights were not reserved by the Province in grants of Crown lands, and in the interval between 1899 and 1944, coal rights were not always reserved in such grants. Since 1944 the Province has discontinued the practice of granting or selling coal rights and has provided access to its coal deposits on the basis of rentals and royalties.

Manitoba, Saskatchewan and Alberta originally formed part of Rupert's Land and the Northwest Territories, control of which came under the jurisdiction of the Governor and Company of Adventurers of England trading into Hudson's Bay (generally known as the Hudson's Bay Company) by right of English Charter. In 1870 the Dominion Government entered into an agreement with the Hudson's Bay Company whereby Canada gained possession of these territories. Under the terms of this agreement the Hudson's Bay Company retained ownership, including the mineral rights, of about 5 per cent of the lands within the "fertile belt" in these territories, the belt being defined in the agreement. Mineral rights covering large areas in these Western Provinces were also alienated from the Crown arising out of land grants to the Canadian Pacific Railway and other railway companies. Saskatchewan, Alberta and Manitoba did not acquire ownership of their resources at the time of their entrance into the Union, these being acquired in 1930. By that time further alienations of coal rights from the Crown had taken place in these territories. This alienation was associated with land grants designed to assist in the opening up of the "West", and included military bounty grants, school land sales, and homestead grants, the latter being the largest factor. Until 1887 conveyances of homestead lands and other Crown granted lands carried mineral rights. Subsequently coal rights were not carried automatically, but could be purchased for a nominal sum. After 1901 any such purchase did not relieve the owner from paying royalties on any

coal mined. From 1907 sales of coal rights were largely discontinued, access to the Crown coal lands being provided by lease on the basis of rentals and royalties. The following information in respect to alienation of coal rights in Alberta prior to 1930 was submitted by the Alberta Government:

Nature of Grant	Acreage	
	No Royalty	Subject to Royalty
Subsidies to Railways	13,031,731.00	
Subsidy to Hudson's Bay Company	2,404,000.00	
Coal Lands Sales, Mining Lands Sales, and Mineral Sales	46,724.44	189,201.99
Unpatented Mineral Sales	....	370.40
Patented after September 1, 1905		
Homesteads	3,007.46	
Special Grants	21,165.73	
Right of Way and Station Grounds	44.79	
Pre-emptions	2,190.52	
Small Lands Sales of Various Kinds	5,817.08	
Military Homesteads, Military Bounty Grants, and North West Mounted Police Grants	647.00	
School Lands Sales	151.01	
Homesteads, etc., patented before September 1, 1905, approximately	250,000.00	
	15,765,479.03	189,572.39

Full particulars of the position in respect to Saskatchewan and Manitoba are not available. It would appear from the limited information available that the position in these provinces was reasonably comparable. This is suggested by the evidence submitted to the Commission by the Saskatchewan Government relating to the Estevan coal field. This coal field covers an area of some 65,920 acres. In 1930 the Province obtained the coal rights on 26,530 acres or 40.3 per cent. Coal rights on the remaining 39,390 acres or 59.7 per cent had been alienated. The coal rights disposed of through mineral sales affect approximately 5,630 acres. A review of the mineral titles in the area reveals the ownership of coal rights in February, 1945, to be as follows:

Crown Coal Rights	Individuals	C.P.R.	Man. & Sask. Coal Co.	West. Dom. Coal Co.	H.B. Co.	Total
Acres	Acres	Acres	Acres	Acres	Acres	Acres
26,530	15,163	12,027	5,800	4,480	1,920	65,920
Per cent 40.3	Per cent 23.0	Per cent 18.2	Per cent 8.8	Per cent 6.8	Per cent 2.9	Per cent 100.0

Thus in review the Dominion Government holds clear title to all coal rights in the Yukon and Northwest Territories, and Nova Scotia and New Brunswick occupy similar positions in respect to their provincial resources. No precise statement can be given of the division of ownership of coal rights in the Western Provinces. These rights have been extensively alienated from the Crown and only a detailed survey can unravel the intricate pattern of ownership which has

arisen out of the long history and innumerable transactions of land and mineral ownership over many generations. In recent years these provinces have been attempting to clarify the position for themselves, and it appears that Alberta and Saskatchewan are making efforts to recover ownership and control of their coal resources.

Various statutes and regulations in each of the provinces concerned provide for control of mining rights in respect to Crown owned coal resources. Under this legislation access to such coal resources is provided for on the basis of rentals and royalties. Provision is also made for the inspection of mining plans in order, to ensure orderly development and maximum recovery of coal by the lessee. The legislation usually provides for control of sub-leasing arrangements, but it does not appear that these provisions are energetically applied. Normally, provision is made for short term prospecting permits with mining leases covering a longer term, usually about 20 years. Nova Scotia has leased considerable areas for a 99-year period with right of renewal for a further 20 years. These leases are held by constituent companies of the Dominion Steel and Coal Corporation Limited. By special arrangement effected in 1892, the Dominion Coal Company Limited and Nova Scotia Steel and Coal Company Limited hold 97 square miles of coal lands on this basis, and the Acadia Coal Company holds a further 19 square miles in the Pictou area on similar terms. The four constituent coal companies hold mining rights covering some 544 square miles, more particulars of which are as follows:

COAL LANDS IN NOVA SCOTIA HELD UNDER LEASE BY SUBSIDIARY COMPANIES OF DOMINION STEEL AND COAL CORPORATION LIMITED

Area	Dominion Coal Co. Ltd.	Cumberland Railway & Coal Co. Ltd.	Nova Scotia Steel & Coal Co. Ltd.*	Acadia Coal Co. Ltd.	Total
	sq. miles	sq. miles	sq. miles	sq. miles	sq. miles
Cape Breton	266	13	95		374
Pictou			3	19	22
Cumberland		148			148
Total	266	161	98	19	544

* Not an operating Company. Leases in Sydney coalfield are operated by Old Sydney Collieries Limited, a subsidiary Company of Dominion Steel and Coal Corporation Limited, on payment of 10 cents a long ton royalty.

In New Brunswick the ownership of mining rights in the Minto coal field is divided among some 32 different lessees and this fragmentary ownership would not appear to be in the best interests of the Province or the coal mining industry. Elsewhere information is not readily available as to the extent to which mining rights are held on Crown owned coal resources.

Each of the coal producing provinces imposes charges on coal mined in the province either in the form of royalties or taxation. In Nova Scotia a rental charge of $30.00 a square mile and a royalty of 12½ cents per long ton is charged on all coal mined with the exception of coal used for domestic purposes by mine workers or in mining operations. Royalty payments are a credit on rentals. In New Brunswick the rental charge is $10.00 per 40 acres, and the royalty 9 cents per short ton. Royalty payments again are a credit on rental. In Manitoba, Saskatchewan and Alberta the rental charge is $1.00 per acre and the royalty 5 cents per short ton. Minor exceptions are made in respect to production for domestic purposes only, where the royalty is 25 cents a short ton in Saskatchewan and 10 cents in Alberta. In addition these provinces receive 7 cents a ton royalties on coal mined in lands alienated from the Crown by mineral sales. Saskatchewan in 1944, and Alberta in 1945, applied mineral taxation to privately owned coal rights, Alberta imposing a tax of 1 cent per acre and Saskatchewan a tax of 3 cents per acre; both Governments are also empowered

to impose a further tax, in Alberta up to 10 mills on the assessed value of coal located in a producing area, in Saskatchewan up to 10 mills on coal lands where mining is being carried on, and 50 cents per acre on non-productive land in producing areas. In addition to providing revenue this legislation has in mind provincial acquisition of mineral resources by forfeiture of mineral rights for non-payment of tax. In British Columbia the rental is $1.00 per acre and the royalty 25 cents per short ton on coal shipped. Crown granted lands assessed as coal lands and under mining development are taxed at 1 per cent of assessed value. Similar lands not under mining development are taxed at 2 per cent of assessed value. There are some 256,438 acres in the first class, and 101,891 acres in the second. A tax of 10 cents a long ton is charged on all coal shipped irrespective of the ownership of the coal rights. This tax does not apply where the provincial royalty is payable or to coal used in the manufacture of coke. Coke oven operators pay 10 cents a long ton on the coke. In both cases this tax is alternative to provincial income tax.

WORLD RESERVES AND RESERVES OF COUNTRIES SUPPLYING CANADIAN MARKET

World Reserves

Very little information is available in respect to world resources of mineable coal. Some idea of the distribution of coal resources can be gathered from the estimates prepared by the Twelfth International Geological Congress in 1913. According to these estimates, coal resources were distributed between the various continents as follows:

	Net tons
Americas	5,627,823,500,000
Asia	1,410,487,600,000
Europe	864,412,600,000
Oceania	187,842,900,000
Africa	63,755,900,000
Total	8,154,322,500,000

It will be seen that, according to these estimates, the American continent possesses nearly 70 per cent of world coal resources. When related to rank, Asia was estimated to have about 80 per cent of world resources of anthracite, and the American continent to have over 70 per cent of bituminous and lignite resources. It will be noted from the following breakdown of the estimate by countries that the United States was considered to have about 52 per cent of the total resources, and Canada to hold second place with about 16 per cent. United States was estimated to have 76 per cent and Canada 24 per cent of the resources of North America.

	Net tons
United States, including Alaska	4,231,352,000,000
Canada	1,360,535,000,000
China	1,097,436,000,000
Germany	466,665,000,000
Great Britain and Ireland	208,922,000,000
Siberia	191,667,000,000
Australia	182,510,000,000
India	87,083,000,000
U.S.S.R. in Europe	66,255,000,000
Union of South Africa	61,949,000,000
Austria	59,387,000,000
Colombia	29,762,000,000
Indo-China	22,048,000,000
France	19,382,000,000
Other countries	69,369,500,000
Total	8,154,322,500,000

Since 1913, various countries have re-estimated their reserves. Russian reserves in 1934 were reported at 1,100 billion tons as against 400 billion tons previously estimated. German estimates were also increased. The United States reserves, on the other hand, were placed in 1942 as 3,178,000,000,000 tons as compared with the previous figure of 4,231,352,000,000 tons. It will be noted that the Commission estimate of Canadian reserves scales down the 1913 estimate from 1,360,535,000,000 tons to approximately 100,000,000,000 tons.

These revisions are, to some extent, the result of the accumulation of new data. In regard to the Commission estimate of Canadian reserves, however, the revision represents the application of totally different yardsticks in the determination of reserves in order to ascertain the extent of known reserves of coal which are available for mining under existing conditions. Thus the figures of this estimate cannot be used for comparative purposes with respect to reserves of other countries. As previously noted, the yardsticks used by the Geological Congress in 1913 were not calculated to yield estimates of mineable or recoverable coal. They are, however, useful in giving some idea of the distribution of coal occurrences throughout the world.

Reserves of Countries Supplying Canadian Market

The principal interest of this Commission in coal reserves outside of Canada relates to the ability of various countries to continue as sources of supply to the Canadian market. From this point of view, interest is concentrated in the reserves of the United States and to a lesser extent, of Great Britain. This is apparent from an analysis of sources of supply to the Canadian market. In 1939, 99 per cent of the imported bituminous coal consumed in Canada came from the United States. Sixty-six per cent of imported anthracite in 1939 came from the United States; and 26 per cent, from the United Kingdom. A further 7 per cent came from Germany. During recent war years the percentage of anthracite imported from the United States increased to nearly 95 per cent. In substance, therefore, our concern is with the United States' reserves of bituminous coal and the United States' and the United Kingdom's reserves of anthracite coal.

UNITED STATES RESERVES

As will be seen from Map 1, the coal deposits of the United States are widely distributed, and large areas of coal lands are present in or near all parts of the country except the Pacific coast region. It is also apparent that the deposits include a variety of coals ranging from anthracite to lignite. In general the western deposits are of low rank, the higher rank coals being largely concentrated in the East. The lower rank coals of the West constitute a large proportion of the United States reserves. Anthracite deposits are largely concentrated in eastern Pennsylvania although small amounts of anthracite and semi-anthracite are mined in other areas. About 70 per cent of the bituminous coal production comes from the Appalachian area which extends from Pennsylvania and Ohio to northern Tennessee. Here also are found the larger tonnages of the better grades of bituminous. Most of the coal shipped to Canada originates in this area. The mid-western fields of Illinois, Indiana, Iowa and West Kentucky, however, are important producers and account for approximately 20 per cent of the total United States output. Relatively large tonnages of Canadian railway fuel were supplied from these fields during the war.

According to the United States Bureau of Mines Information Circular I.C. 7261, November, 1943, the United States reserves of mineable* coal were as follows at January, 1942:

Rank of Coal	Reserve January 1, 1942 (net tons)
Anthracite	15,000,000,000
Low Volatile Bituminous**	53,000,000,000
High Volatile Bituminous**	1,353,000,000,000
Sub-bituminous	818,000,000,000
Lignite	939,000,000,000
Total, all ranks	3,178,000,000,000

In respect to bituminous coal, the principal sources of Canadian supply are United States coal districts 1, 2, 3, 4, 6 and 8 which are, in the same order, Central Pennsylvania, Western Pennsylvania, Northern West Virginia, Ohio, West Virgina Panhandle, and Southern High Volatile. Southern High Volatile district embraces Southern West Virginia, Virginia, Eastern Kentucky and Tennessee. These districts contain over 40 per cent of the bituminous coal reserves of the United States.

During the course of the Commission's enquiry, a number of the principal operators in these districts, who supply Canada with more than 50 per cent of the total imported United States bituminous coal, assured the Commission that the reserves of available bituminous coal are almost unlimited, and that there need be no anxiety in Canada as to a continuous supply of high grade bituminous coals from the United States.

Elsewhere in the report reference is made to the anxiety which was felt both in the United States and Canada in the early 'twenties regarding the adequacy of anthracite reserves in the United States. During the course of our enquiry, the Commission has received adequate assurances from the Federal Bureau of Mines, the Topographic and Geologic Survey of the Commonwealth of Pennsylvania the chief source of supply of United States anthracite to the Canadian market, and the anthracite operators themselves to the effect that the anthracite reserves are adequate to assure continued supply at the current level of production for more than one hundred years. According to the Commonwealth Topographic and Geologic Survey, Pennsylvania in 1945 had anthracite reserves in excess of 15,000,000,000 short tons. There is some evidence, however, to show that mining costs are increasing in the anthracite industry. The coal presently mined is deeper and in underground mining to-day 20 tons of water must be raised for every ton of coal. The thicker seams are being exhausted and the thinner seams are now being mined. It is possible, therefore, that while supplies may be adequate, the price of anthracite may increase.

UNITED KINGDOM ANTHRACITE

Various estimates of United Kingdom coal reserves have been made. Based on seams 12 inches or more in thickness and within 4,000 feet of the surface, the estimates have varied between 131,000 million and 190,000 million long tons. A preliminary appraisal of the findings of a very recent survey of United Kingdom

* Basis of estimate was minimum thickness of 14 inches for bituminous and anthracite, 2 feet for sub-bituminous and 3 feet for lignite, with a maximum depth of cover of 3,000 feet. Specific gravity was assumed to be 1.3.

** Includes some medium volatile coal.

reserves appears in Survey Paper No. 58, 1946, Department of Scientific and Industrial Research. This survey, known as the "Rapid Survey," was restricted to coal likely to be mined during the next 100 years. The following is extracted from Survey Paper No. 58:

Type of Coal	Developed reserves (=Total planned output for 1942–2042)		Projected annual output (Average, 1942–52)	
	Millions of long tons	Per cent	Millions of long tons	Per cent
Anthracite	704.6	3.4	8.239	3.5
Low- and medium-volatile steam coals	1,861.9	9.1	22.086	9.3
Medium-volatile coking coals	1,556.2	7.6	22.229	9.3
High-volatile strongly caking and medium caking coals, i.e. coking-gas and gas coals	7,402.3	36.1	88.016	37.0
High-volatile weakly caking coals	2,894.4	14.1	33·513	14.0
High-volatile very weakly caking and non-caking coals	5,634.1	27.5	63.391	26.6
Unclassified	446.9	2.2	0.671	0.3
Total	20,500.4	100.0	238.145	100.0

A considerable percentage of anthracite produced in Great Britain came to the Canadian market in normal years before the war, and it is clear from the estimate that the reserves are sufficient to allow the United Kingdom to continue to supply the Canadian market. It is not clear from the present condition of the industry in the United Kingdom that Canada can rely on a continuous supply of anthracite at pre-war prices.

CHAPTER II

HISTORY OF PRODUCTION

This chapter contains a brief history of coal production in Canada. It is designed to provide background helpful in understanding current problems of the industry. In general, the method followed is first to review production statistics for the country as a whole, and then to review production statistics for the coal producing provinces. Within the Province of Alberta and British Columbia, some attention has been paid to individual regions. Considerable attention has also been given to the influence of exports on production.

Total production prior to Confederation was 3,000,000 tons. Somewhat more than three-quarters of this tonnage was mined in the Maritime Provinces, principally on Cape Breton Island; the remainder came from Vancouver Island. At Confederation total Canadian production was slightly over 600,000 tons per year. Production from 1867 to 1944 has been as follows:

Year	Short Tons	Year	Short Tons	Year	Short Tons
1867	631,320	1893	3,783,499	1919	13,919,096
1868	623,392	1894	3,847,070	1920	16,946,764
1869	687,825	1895	3,478,344	1921	15,057,493
1870	752,635	1896	3,745,716	1922	15,157,431
1871		1897	3,786,107	1923	16,990,571
1872	3,033,152	1898	4,173,108	1924	13,638,197
1873		1899	4,925,051	1925	13,134,968
1874	1,063,742	1900	5,777,319	1926	16,478,131
1875	1,039,974	1901	6,486,325	1927	17,426,861
1876	994,762	1902	7,466,681	1928	17,564,293
1877	1,036,670	1903	7,960,364	1929	17,496,557
1878	1,089,744	1904	8,254,595	1930	14,881,324
1879	1,126,497	1905	8,667,948	1931	12,243,211
1880	1,482,714	1906	9,762,601	1932	11,738,913
1881	1,537,106	1907	10,511,426	1933	11,903,344
1882	1,848,148	1908	10,886,311	1934	13,810,193
1883	1,818,684	1909	10,501,475	1935	13,888,006
1884	1,984,959	1910	12,909,152	1936	15,229,182
1885	1,920,977	1911	11,323,388	1937	15,835,954
1886	2,116,653	1912	14,512,829	1938	14,294,718
1887	2,429,330	1913	15,012,178	1939	15,692,698
1888	2,602,552	1914	13,637,529	1940	17,566,884
1889	2,658,303	1915	13,267,023	1941	18,225,921
1890	3,084,682	1916	14,483,395	1942	18,865,030
1891	3,577,749	1917	14,046,759	1943	17,859,057
1892	3,287,745	1918	14,977,926	1944	17,026,499

SOURCE.—Coal Statistics for Canada.

For Canada as a whole, production figures show a steady growth, interrupted only three times: at the beginning of the first World War, in the mid 'twenties, and by the depression of the 'thirties. A substantial degree of recovery from the low production levels of the depression years had already been achieved when World War II started, and new all-time peaks in production were achieved during the war years.

For the past thirty-five years, however, this growth has been almost entirely the result of expansion in Alberta and Saskatchewan. The trend of production in New Brunswick has been generally upwards since 1910, but the tonnages involved are small. Nova Scotia production reached its peak in 1913; the highest production achieved in the recent war years was still below the levels attained thirty years previously. British Columbia reached its highest production in 1910.

Export figures covering the period 1873 to date are as follows:

Year	Short Tons	Year	Short Tons	Year	Short Tons
1873	420,683	1897	986,130	1921	1,987,251
1874	310,988	1898	1,150,029	1922	1,818,582
1875	250,348	1899	1,293,169	1923	1,654,406
1876	248,638	1900	1,787,777	1924	773,246
1877	301,317	1901	1,573,661	1925	785,910
1878	327,959	1902	2,090,268	1926	1,028,200
1879	306,648	1903	1,954,629	1927	1,113,330
1880	432,188	1904	1,557,412	1928	863,941
1881	395,382	1905	1,635,287	1929	842,972
1882	412,682	1906	1,835,041	1930	624,512
1883	486,811	1907	1,894,074	1931	359,853
1884	474,405	1908	1,729,833	1932	285,487
1885	427,937	1909	1,588,099	1933	259,233
1886	520,703	1910	2,377,049	1934	306,335
1887	580,965	1911	1,500,639	1935	418,391
1888	588,627	1912	2,127,133	1936	411,574
1889	665,315	1913	1,562,020	1937	355,268
1890	724,486	1914	1,423,126	1938	353,181
1891	971,259	1915	1,766,543	1939	376,203
1892	823,733	1916	2,135,359	1940	504,898
1893	960,312	1917	1,733,156	1941	531,449
1894	1,103,694	1918	1,817,195	1942	815,585
1895	1,011,235	1919	2,070,050	1943	1,110,101
1896	1,106,661	1920	2,558,174	1944	1,010,240

SOURCE.—Coal Statistics for Canada.

It will be noted that a general expansion of exports took place until the turn of the century, and exports then continued in the general range of 1,500,000 to 2,000,000 tons per annum until after the end of the first World War, although with marked fluctuations occurring from year to year. In 1920 exports reached their all-time peak of over 2,500,000 tons, following which there was a steady recession to a low of 259,000 tons in 1933. Exports did not rise much above 400,000 tons until the war years.

In 1875 exports took 25 per cent of Canadian production; in 1900 over 35 per cent. A steady decline then started, and by 1910 about 20 percent of production went to export markets, by 1920 only 15 per cent, and in 1930 barely over 4 per cent. In 1933 exports took only 2.2 per cent of Canadian output, and until the start of the war did not take over 6 per cent in any succeeding year.

The origin of coal for Canadian consumption is shown by the following table:

Year	Canadian		Imported	
	Short Tons	Percentage	Short Tons	Percentage
1902	5,376,413	53.1	4,734,559	46.9
1903	6,005,735	47.3	6,678,450	52.7
1904	6,697,183	47.9	7,297,482	52.1
1905	7,032,661	49.4	7,215,446	50.6
1906	7,927,560	50.5	7,758,325	49.5
1907	8,617,352	45.0	10,549,503	55.0
1908	9,156,478	47.3	10,195,424	52.7
1909	8,913,376	47.9	9,711,826	52.1
1910	10,532,103	50.2	10,438,123	49.8
1911	9,822,749	40.5	14,424,949	59.5
1912	12,385,696	46.0	14,549,104	54.0
1913	13,450,158	42.6	18,132,387	57.4
1914	12,214,403	45.5	14,637,920	54.5
1915	11,500,480	48.1	12,406,212	51.9
1916	12,348,036	41.3	17,517,820	58.7
1917	12,313,603	37.2	20,810,132	62.8

Year	Canadian		Imported	
	Short Tons	Per-centage	Short Tons	Per-centage
1918	13,160,731	37.8	21,611,101	62.2
1919	11,611,168	40.3	17,236,269	59.7
1920	14,025,566	42.9	18,668,741	57.1
1921	12,715,734	41.1	18,258,387	58.9
1922	13,044,352	50.2	12,962,189	49.8
1923	15,070,962	41.8	20,967,971	58.2
1924	12,529,358	42.8	16,714,143	57.2
1925	12,125,290	42.6	16,331,971	57.4
1926	15,086,296	47.7	16,565,555	52.3
1927	15,944,983	46.7	18,177,303	53.3
1928	16,487,807	50.0	16,515,582	50.0
1929	16,387,461	48.0	17,724,132	52.0
1930	14,052,671	43.3	18,412,039	56.7
1931	11,682,779	47.7	12,828,327	52.3
1932	11,212,701	49.0	11,654,492	51.0
1933	11,456,273	51.5	10,808,962	48.5
1934	13,236,406	51.1	12,651,168	48.9
1935	13,306,303	53.1	11,735,835	46.9
1936	14,508,652	53.3	12,719,515	46.7
1937	15,172,729	51.5	14,268,585	48.5
1938	13,800,094	52.3	12,573,872	47.6
1939	14,902,915	50.6	14,564,679	49.4
1940	16,666,234	49.5	17,036,090	50.5
1941	17,227,151	46.2	20,026,082	53.8
1942	17,725,761	42.0	24,529,361	58.0
1943	16,321,006	37.1	27,695,098	62.9
1944	15,660,808	35.7	28,166,201	64.3

Source: Coal Statistics for Canada.

The point of primary interest in these figures is that the Canadian production has for the past forty years held a remarkably constant proportion of the Canadian coal market. The only two periods of sharp divergence from the general pattern have been in the two periods of war when the demands of industry increased the proportion of United States coal used in the country, and the proportion of the demand filled by Canadian production was approximately the same in each of these war periods. In the years immediately preceding World War II Canadian production met a larger proportion of Canadian demands than at any time in the past forty years.

It is of interest to note the position of Canada as a coal producer relative to the other coal producing areas of the world. Information is not readily available for years since the start of the war, but in 1938 the total Canadian production of 14,295,000 tons can be compared with a world production in excess of 1,400,000,000 tons. In that year the principal producing countries were Germany (397,000,000 tons), United States (349,000,000 tons), Great Britain (227,000,000 tons), and Russia (130,000,000 tons). During the war years United States production grew to over 650,000,000 tons per annum. By far the greater portion of world production is bituminous coal, upon which practically the entire industrial development of such countries as the United States, Great Britain, and Germany has been based. Canadian production is largely bituminous, with the remainder being sub-bituminous or lignite.

NOVA SCOTIA

Although mining was carried on intermittently from 1720, it was not important until the General Mining Association commenced operations in 1830. The mining industry of Cape Breton did not develop as well as anticipated, and in 1857 production was only 117,000 tons. In that year the Government of Nova

Scotia acquired the ownership of mineral rights previously held by the General Mining Association, and in the succeeding years several new mines were opened.

The bulk of Nova Scotia production is from Cape Breton Island; there is also production on the mainland of Nova Scotia in Cumberland and Pictou Counties. A detailed record of production and exports of Nova Scotia coal follows. For the year 1901 to date, production is shown by areas, as well as for the Province as a whole:

PRODUCTION—NOVA SCOTIA—1785-1900 AND EXPORTS 1874-1900

Date	Production	Exports	Date	Production	Exports
1785-1866	2,649,416		1884	1,556,011	222,709
1867	596,332		1885	1,514,470	176,287
1868	574,106		1886	1,682,924	240,459
1869	647,727		1887	1,871,330	207,941
1870	719,211		1888	1,989,263	165,863
1871	754,827		1889	1,967,032	186,608
1872	986,664		1890	2,222,081	202,387
1873	1,177,643		1891	2,290,158	194,867
1874	977,446	252,124	1892	2,175,913	181,547
1875	874,905	179,626	1893	2,489,807	203,198
1876	794,804	126,520	1894	2,520,707	310,277
1877	848,398	173,389	1895	2,239,727	241,091
1878	863,075	154,114	1896	2,537,706	380,149
1879	882,863	113,742	1897	2,020,835	307,128
1880	1,156,635	119,552	1898	2,584,175	309,158
1881	1,259,183	193,081	1899	3,209,296	459,260
1882	1,529,708	218,954	1900	3,694,646	Not available
1883	1,503,259	192,795			

PRODUCTION—NOVA SCOTIA AND BY DISTRICTS AND EXPORTS, 1901-1944

Date	Total	Production				Exports
		Cape Breton		Cumberland	Pictou	
		Sydney Coalfield	Other			
1901	4,279,557	3,116,641	40,303	538,773	533,840	767,683
1902	5,292,538	3,886,903	148,539	621,791	635,305	1,170,430
1903	5,841,429	4,073,824	296,110	679,332	792,164	1,175,167
1904	5,747,823	3,973,433	332,146	731,316	710,928	975,124
1905	5,821,622	4,248,970	210,698	693,500	668,454	982,437
1906	6,546,191	4,804,407	312,554	659,734	769,496	Not available
1907	6,468,563	4,698,147	395,836	534,047	840,533	Not available
1908	6,805,489	4,840,653	452,877	662,157	849,802	Not available
1909	5,718,871	4,081,333	398,759	494,919	748,860	400,392
1910	6,515,162	5,035,800	414,153	350,363	714,846	579,837
1911	7,125,551	5,405,355	347,944	538,296	833,956	621,704
1912	7,834,724	6,039,296	312,836	716,914	765,678	675,871
1913	8,135,104	6,313,275	329,108	675,544	817,177	680,224
1914	7,448,042	5,767,560	296,624	702,496	681,356	639,460
1915	7,513,739	5,920,670	275,049	736,794	581,226	867,846
1916	6,911,995	5,317,756	296,111	685,517	612,611	723,645
1917	6,345,335	4,680,650	227,529	711,164	725,992	611,406
1918	5,836,370	4,294,832	234,678	722,139	584,721	529,985
1919	5,804,674	4,144,495	216,790	688,981	754,408	994,107
1920	6,495,237	4,553,845	278,193	779,555	883,644	920,477
1921	5,734,928	4,244,172	186,755	694,398	609,603	790,562
1922	5,569,072	4,069,239	175,181	681,018	643,634	678,245
1923	6,597,838	4,661,373	164,681	862,087	909,697	758,789
1924	5,557,441	4,135,693	88,474	674,806	658,468	356,657
1925	3,842,978	2,568,071	149,668	518,733	606,506	262,299
1926	6,747,477	5,091,664	147,139	715,578	793,096	582,818
1927	7,071,876	5,402,531	129,520	663,407	876,418	584,546
1928	6,743,504	5,070,017	135,866	730,891	806,730	370,119
1929	7,056,133	5,380,652	157,470	795,714	722,297	371,744
1930	6,252,552	5,594,446	155,088	802,266	700,752	374,878

PRODUCTION—NOVA SCOTIA AND BY DISTRICTS AND EXPORTS, 1901-1944—concluded

Date	Total	Production				Exports
		Cape Breton		Cumberland	Pictou	
		Sydney Coalfield	Other			
1931	4,955,563	3,449,472	140,505	694,097	671,489	206,865
1932	4,084,581	2,831,753	120,909	634,516	497,403	158,805
1933	4,557,590	3,444,118	102,628	604,893	405,951	170,521
1934	6,341,625	4,926,085	116,872	738,017	560,651	209,931
1935	5,822,075	4,413,570	116,978	702,496	589,031	292,807
1936	6,649,102	5,158,877	142,540	701,767	645,918	269,983
1937	7,256,954	5,490,819	186,927	807,651	771,557	198,911
1938	6,236,417	4,676,730	173,535	713,768	672,384	188,025
1939	7,051,176	5,413,615	121,374	808,051	708,136	190,087
1940	7,848,921	5,896,839	173,122	929,497	849,463	283,723
1941	7,387,762	5,384,375	152,795	1,064,244	786,348	316,968
1942	7,204,852	5,289,250	120,957	1,123,029	671,616	475,241
1943	6,103,085	4,435,018	96,085	971,206	600,776	466,167
1944	5,745,671	4,225,683	93,400	880,799	545,789	464,556

SOURCE: All figures are from Coal Statistics for Canada with the following exceptions: From 1872 to 1920 production statistics are taken from annual reports of the former Bureau of Mines. Export figures for the years up to 1899 are taken from Trade and Navigation records of the Dominion Government. These figures were not recorded by provinces after 1899. From 1900 to 1920, inclusive, there are no customs figures for coal on a provincial basis, and the figures used are shipments by Nova Scotia operators direct to foreign destinations as shown in Coal Statistics for Canada. These figures do not reflect accurately exports as an appreciable tonnage of Nova Scotia coal is exported through Nova Scotia and New Brunswick ports by persons other than the operators. For the years 1921 to 1944 an estimate of Nova Scotia exports has been made by subtracting from the total exports of Canadian coal from Nova Scotia and New Brunswick ports as recorded by Customs the export shipment recorded by mine operators of the Province of New Brunswick.

There was a steady growth in production in Nova Scotia in the years immediately following Confederation, output approximately doubling between 1867 and 1873 and reaching almost 1,200,000 tons in the latter year. It then fell off during the depression of the 1870's. Prior to Confederation, export markets were of primary importance. With the abrogation of the Reciprocity Treaty in 1866 there was a sharp reduction in exports to the United States, which at that time were taking over 50 per cent of total production. Total exports fell both absolutely and relatively to only 20 per cent of production in 1875 and 10 per cent in 1880. This loss was offset by development of new markets in the St. Lawrence Valley. National fiscal policy from 1879 had considerable influence on Nova Scotia coal mining—directly by coal tariffs and indirectly by development of industries which have consumed a substantial proportion of Nova Scotia production.

In 1880 production again exceeded one million tons and continued a steady growth, almost doubling between 1885 and 1891 and again between 1891 and 1901. The stimulus to coal production from railway building and the development of iron and steel and other coal consuming industries was very important, the greatest development coming with the establishment of a primary steel industry at Sydney in 1901. Exports increased again at the turn of the century, but continued to take only about 10 per cent of the output—a ratio which was maintained until the 1920's.

Production continued to grow until 1913, when it reached its all-time peak of 8,135,000 tons. The end of railway expansion left the iron and steel industry of the Maritime Provinces with the problem of finding other markets, and

industry in Canada was tending to concentrate in parts of the country where the use of Nova Scotia coal was not profitable. The St. Lawrence trade, which had grown steadily until the start of the first World War, was moved chiefly by water. Exigencies of the war brought about the loss of most of the vessels used for this movement, and the Quebec market was largely lost. This was counteracted by an increasing local demand due to wartime industrial activity in the steel mills and general industry and increased demands upon the transportation system.

The St. Lawrence market was largely recovered by Nova Scotia following the war, but during the 1920's the steel industry of the Maritime Provinces experienced serious reverses. A series of strikes also tended to keep production down, the most serious being in 1925 when production fell to 3,843,000 tons. There was a further loss of export markets during the 1920's, and exports since that time have rarely taken more than 5 per cent of output. To stimulate Nova Scotia production a system of transportation subventions was developed by the Federal Government which came into full effect by 1931, and the customs tariff was increased the same year. During the depression of the 'thirties production fell off sharply and then recovered somewhat. Over the period from 1913 to 1938, with the exception of the serious strike year of 1925 and the early years of the depression, production held within the comparatively narrow range of 5,500,000 to 7,000,000 tons per annum. Under stimulus of wartime demands it rose again during the early war years to 7,848,000 tons in 1940, falling off to approximately 5,750,000 tons in 1944.

NEW BRUNSWICK

Mining started in New Brunswick about 1825. New Brunswick production did not exceed 1 per cent of the Canadian total until 1916 and was less than 3 per cent at its all-time peak of 547,000 tons reached in 1940. By 1944 it had dropped to 345,000 tons.

The following table shows that coal production in New Brunswick has fluctuated considerably:

Year	Short Tons	Year	Short Tons	Year	Short Tons
1887	10,040	1906	34,076	1925	208,012
1888	5,730	1907	34,584	1926	173,111
1889	5,673	1908	60,000	1927	203,950
1890	7,110	1909	49,029	1928	207,738
1891	5,422	1910	55,455	1929	218,706
1892	6,768	1911	55,781	1930	209,349
1893	6,200	1912	44,780	1931	182,181
1894	6,469	1913	70,311	1932	212,695
1895	9,500	1914	98,049	1933	312,303
1896	7,500	1915	127,391	1934	314,750
1897	6,000	1916	143,540	1935	346,024
1898	6,160	1917	189,095	1936	368,618
1899	10,528	1918	268,212	1937	364,714
1900	10,000	1919	166,377	1938	342,238
1901	17,630	1920	171,610	1939	468,421
1902	18,795	1921	187,192	1940	547,064
1903	16,000	1922	287,513	1941	523,344
1904	9,112	1923	276,617	1942	435,203
1905	29,400	1924	217,121	1943	372,873
				1944	345,123

Source: Coal Statistics for Canada.

Completion in 1905 of a railway connecting the Minto coal field with the Intercolonial assisted the development of the industry. Heavy railway demands during World War I provided a further stimulus to production, which reached a peak of 268,000 tons in 1918. This sharp increase was achieved largely through the introduction of strip mining. Production fluctuated until 1924, when it became stable at about 200,000 tons annually until 1932. From 1933 a steady increase is recorded until 1939. During the early war years a considerable increase was achieved largely through stripping operations.

The market for New Brunswick coal has been limited almost entirely to local uses within the Province, and production has not been greatly affected by changes in tariffs or introduction of transportation subventions.

SASKATCHEWAN

Production in Saskatchewan is concentrated in the Estevan area, with limited output in the Wood Mountain-Willowbunch and in the Cypress Hills districts. The coal produced in Saskatchewan is all lignite.

The record of production in Saskatchewan is as follows:

Year	Short Tons	Year	Short Tons	Year	Short Tons
1892	5,400	1910	181,156	1928	471,713
1893	8,325	1911	206,779	1929	580,189
1894	15,051	1912	225,342	1930	579,424
1895	15,769	1913	212,897	1931	662,836
1896	16,706	1914	232,299	1932	887,139
1897	25,000	1915	240,107	1933	927,649
1898	25,000	1916	281,300	1934	909,288
1899	25,000	1917	355,445	1935	921,785
1900	40,500	1918	346,847	1936	1,020,792
1901	45,000	1919	379,347	1937	1,049,348
1902	70,400	1920	335,222	1938	1,022,166
1903	116,703	1921	335,632	1939	960,000
1904	124,885	1922	382,437	1940	1,097,517
1905	107,596	1923	438,100	1941	1,322,763
1906	108,398	1924	479,118	1942	1,301,116
1907	151,232	1925	471,965	1943	1,665,972
1908	150,556	1926	439,803	1944	1,372,766
1909	192,125	1927	470,216		

SOURCE: Coal Statistics for Canada.

Before 1930 the output of the Saskatchewan mines was used almost entirely for domestic purposes in Saskatchewan and Manitoba, although in the 'twenties the railroads started to take a substantial tonnage for stationary installations. Production in this period was less than 500,000 tons per annum.

About 1930 several factors combined to stimulate production. Stripping operations, which had been carried on for some years in a small way, were undertaken on a large scale by a new operator. In addition, an effective campaign was undertaken to educate potential consumers in the technique of using lignite coals. The depression years aided this campaign by producing a consumer demand for cheaper fuels. Prior to 1930 the main product of the Saskatchewan fields was lump coal for domestic use. At the present time industrial sizes comprise about 70 per cent of the output. In 1943 Saskatchewan production represented almost 10 per cent of the Canadian total.

ALBERTA

Production in Alberta started with railway construction by the Canadian Pacific Railway Company. Development of other coal fields followed railway construction by the Grand Trunk Pacific in 1911 and 1912, and by the Canadian Northern Railway in 1913. The railways provided a market in themselves and afforded transportation facilities to other markets. The development of Alberta production from practically nothing in 1880 to over 4,250,000 tons in 1913 is tied directly to railroad expansion. In the case of the Crowsnest Pass area, development of the metallurgical plants in British Columbia and the United States was an added factor.

Production of coal in Alberta has been as follows:

ALBERTA—PRODUCTION

Date	Short Tons	Date	Short Tons	Date	Short Tons
1886	43,220	1906	1,385,000	1926	6,508,908
1887	74,152	1907	1,834,745	1927	6,936,780
1888	115,124	1908	1,845,000	1928	7,334,179
1889	97,364	1909	2,174,329	1929	7,147,250
1890	128,753	1910	3,036,757	1930	5,755,911
1891	174,131	1911	1,694,564	1931	4,564,290
1892	178,970	1912	3,446,349	1932	4,870,030
1893	230,070	1913	4,306,346	1933	4,714,784
1894	184,940	1914	3,821,739	1934	4,748,848
1895	169,885	1915	3,434,891	1935	5,462,973
1896	209,162	1916	4,638,604	1936	5,696,375
1897	242,163	1917	4,863,414	1937	5,551,682
1898	315,088	1918	6,148,620	1938	5,230,015
1899	309,600	1919	5,022,412	1939	5,518,105
1900	311,450	1920	6,908,923	1940	6,205,088
1901	340,275	1921	5,937,195	1941	6,970,064
1902	402,819	1922	5,976,432	1942	7,754,279
1903	495,893	1923	6,866,923	1943	7,677,982
1904	661,732	1924	5,203,713	1944	7,427,433
1905	931,917	1925	5,883,394		

SOURCE: Figures up to 1906 are from Coal Statistics for Canada. From 1906 to 1944 inclusive they are taken from the annual reports of the Alberta Department of Mines.

The only interruption to the steady growth of production in Alberta up to the start of World War I was in 1911, when a serious strike cut production in half. During the early war years production fell, but later output expanded to surpass 6,000,000 tons in 1918.

Cessation of war demands combined with a strike brought production down in 1919, but the following year a new peak was attained. Output continued to rise substantially throughout the 'twenties. At this time United States anthracite was permanently displaced by western coal in the Manitoba market.

In 1928 production reached a high point of 7,334,000 tons. During the early 'thirties the depression brought a decline although transportation subventions, introduced by the Federal Government in 1931, to promote the eastern movement of Alberta coal, helped minimize its effects. Output rose again to over 7,750,000 tons by 1942. For the past thirty-five years the growth in Canadian production has been primarily the result of increased production in Alberta.

In Alberta coal is usually classified as "steam" or "domestic". The following figures show total production of coal in Alberta according to this classification:

ALBERTA—PRODUCTION BY COALS

Date	"Domestic" Coal	"Steam" Coal	Date	"Domestic" Coal	"Steam" Coal
1906	602,780	782,220	1926	3,160,029	3,348,879
1907	639,335	1,195,410	1927	3,357,171	3,579,609
1908	584,334	1,250,666	1928	3,378,200	3,955,979
1909	763,673	1,410,656	1929	3,385,749	3,761,501
1910	878,011	2,158,746	1930	2,874,090	2,881,821
1911	964,700	729,864	1931	2,246,544	2,317,746
1912	1,341,389	2,104,960	1932	2,576,831	2,293,199
1913	1,763,225	2,543,121	1933	2,434,047	2,280,737
1914	1,697,401	2,124,338	1934	2,295,566	2,453,282
1915	1,682,922	1,751,969	1935	2,647,912	2,815,061
1916	2,172,801	2,475,803	1936	2,841,231	2,866,144
1917	2,537,829	2,325,585	1937	2,631,150	3,137,679
1918	3,035,061	3,113,559	1938	2,453,263	2,776,762
1919	3,611,009	2,411,403	1939	2,449,199	3,068,906
1920	3,359,309	3,549,615	1940	2,537,205	3,667,883
1921	2,943,141	2,994,054	1941	2,713,254	4,256,810
1922	3,086,669	2,889,763	1942	3,213,113	4,541,166
1923	3,161,741	3,705,289	1943	3,416,037	4,261,945
1924	3,096,660	2,107,053	1944	3,146,801	4,280,632
1925	3,156,359	2,727,035			

SOURCE: Annual Report of Alberta Department of Mines.

Development of production of "steam" coal was much more rapid than of "domestic" coal during the period of railway building in Western Canada. During the years of World War I "domestic" production increased until it equalled that of "steam" coal. At the present time "steam" coal comprises about 58 per cent of Alberta production.

Records relating to exports from Alberta are not satisfactory, but following are some figures which will illustrate their limited extent. For most of its production history, exports have taken only 1 per cent or 2 per cent of Alberta's output.

ALBERTA—EXPORTS

Date	Short Tons	Date	Short Tons	Date	Short Tons
1909	114,101	1921	146,200	1933	18,498
1910	243,371	1922	113,165	1934	13,925
1911	40,884	1923	83,705	1935	32,785
1912	93,126	1924	44,678	1936	29,727
1913	139,536	1925	49,757	1937	47,013
1914	105,699	1926	48,012	1938	35,910
1915	25,050	1927	46,042	1939	35,373
1916	60,124	1928	52,976	1940	37,665
1917	90,239	1929	51,247	1941	34,890
1918	132,765	1930	44,235	1942	101,394
1919	121,264	1931	30,629	1943	459,551
1920	132,918	1932	27,030	1944	293,545

SOURCE: Figures for years 1909 to 1920 inclusive are taken from annual reports of the former Bureau of Mines. In later years they are taken from Coal Statistics for Canada.

BRITISH COLUMBIA

Production of coal in British Columbia was confined to Vancouver Island until 1898. Output was insignificant prior to 1850, when coal miners and machinery were brought in from the United Kingdom. With the construction of the Canadian Pacific line through the Crowsnest Pass, mining developed in that area in 1898. In the period 1906 to 1910 a number of mines were opened in south-central British Columbia in areas commonly referred to as the Inland fields.

The following table shows production of coal in long tons for the Province by principal producing fields:

COAL PRODUCTION—BRITISH COLUMBIA

(Long Tons)

Date	Total	Vancouver Island	Crowsnest Pass	Inland
1836-1866	191,437	191,437		
1867	31,239	31,239		
1868	44,005	44,005		
1869	35,802	35,802		
1870	29,843	29,843		
1871 1872 1873	148,459	148,459		
1874	81,061	81,061		
1875	97,644	97,644		
1876	140,184	140,184		
1877	139,692	139,692		
1878	190,848	190,848		
1879	232,390	232,390		
1880	272,362	272,362		
1881	229,514	229,514		
1882	288,572	288,572		
1883	214,955	214,955		
1884	393,866	393,866		
1885	333,024	333,024		
1886	335,192	335,192		
1887	434,055	434,055		
1888	481,667	481,667		
1889	568,249	568,249		
1890	685,345	685,345		
1891	1,009,131	1,009,131		
1892	836,802	836,802		
1893	976,768	976,768		
1894	993,418	993,418		
1895	944,683	944,683		
1896	894,882	894,882		
1897	892,295	892,295		
1898	1,135,865	1,126,531	9,334	
1899	1,306,324	1,203,199	103,125	
1900	1,590,179	1,383,376	206,803	
1901	1,691,557	1,312,202	379,355	
1902	1,641,626	1,173,893	223,501	
1903	1,450,663	860,775	589,888	
1904	1,685,698	1,023,013	662,685	
1905	1,825,832	993,899	831,933	
1906	1,899,076	1,178,627	720,449	
1907	2,219,608	1,332,009	876,731	10,868
1908	2,109,387	1,200,582	883,205	25,600
1909	2,400,600	1,414,375	923,865	62,360
1910	3,139,235	1,616,030	1,365,119	158,086
1911	2,297,718	1,625,122	442,057	230,539
1912	3,025,709	1,558,240	1,261,212	206,257
1913	2,570,760	973,493	1,331,725	265,542
1914	2,166,428	1,072,314	955,183	138,931
1915	1,972,580	1,020,942	852,572	99,066
1916	2,485,580	1,492,761	882,270	110,549
1917	2,398,715	1,695,721	551,751	151,243
1918	2,578,724	1,666,211	732,864	179,649

COAL PRODUCTION—BRITISH COLUMBIA—concluded

(Long Tons)

Date	Total	Vancouver Island	Crowsnest Pass	Inland
1919	2,408,948	1,699,348	558,806	150,794
1920	2,696,774	1,698,254	847,389	151,131
1921	2,569,639	1,625,931	759,755	183,953
1922	2,580,915	1,754,656	554,361	271,898
1923	2,542,987	1,574,663	740,531	227,793
1924	1,987,533	1,486,332	273,518	227,683
1925	2,444,292	1,412,757	854,480	177,055
1926	2,330,036	1,293,175	848,448	188,413
1927	2,453,827	1,331,325	907,519	214,983
1928	2,526,702	1,277,533	1,001,523	247,646
1929	2,251,252	1,120,805	886,706	243,741
1930	1,887,130	988,805	689,236	209,089
1931	1,707,590	831,925	661,426	214,239
1932	1,534,975	749,006	587,875	198,094
1933	1,264,746	613,203	477,677	173,866
1934	1,347,090	574,508	627,619	144,963
1935	1,187,968	630,213	407,110	150,645
1936	1,346,471	713,037	470,606	162,828
1937	1,444,687	818,447	459,136	167,104
1938	1,309,428	684,398	434,068	190,962
1939	1,477,872	717,334	561,958	198,580
1940	1,667,827	732,659	776,518	158,650
1941	1,802,353	647,958	1,026,053	128,337
1942	1,938,158	738,600	1,047,713	151,845
1943	1,821,654	729,989	927,482	164,183
1944	1,933,639	689,714	1,120,665	123,260
1945	1,518,673	557,778	869,647	91,248

Source: Up to 1896 the figures are from Coal Statistics for Canada converted to long tons. From 1896 to 1944 inclusive they are from annual reports of the British Columbia Department of Mines.

It will be noted from the table that production increased more or less steadily until 1910, when an all-time peak of over 3,000,000 long tons was reached. After 1898 the continuing upward trend was due largely to operations in the Crowsnest Pass to supply the growing requirements of railways and metallurgical iudustries in British Columbia and in the United States. Total production in the Province dropped sharply in 1930, and has not since regained the level attained in the 'twenties. Declining output on Vancouver Island from the mid 'twenties to the mid 'thirties was the dominant feature in this connection. During World War II the Crowsnest Pass area became the major producing field in the Province.

The outstanding influence on British Columbia coal production during the last twenty-five years has been intense competition with alternative fuels—particularly fuel oil. The effect of this competition on export markets is discussed later. Within the Province the most important developments were the growing use of oil-burning locomotives by the railways after 1917 and of oil for ships' bunkerage. The sharp temporary declines in 1911, 1913 and 1924 reflect industrial disputes. The effect of the depression of the 'thirties on production was mitigated to some extent by the introduction of transportation subventions and Federal subsidies on coal delivered for ships' bunkerage or exported other than to the United States.

Export markets have been relatively more important to British Columbia mines than to those of any other part of Canada. Development of Vancouver Island production was in a considerable degree based upon the existence of a large export market in California and other Pacific Coast States; and from time to time exports were made to other Pacific areas, such as Alaska, Chile, the

Hawaiian Islands and Japan. The development of the Crowsnest Pass area was stimulated by the demands of railways and metallurgical industries in the United States.

The export position of British Columbia mines cannot be fully appreciated unless particular reference is made to coke as well as to coal. A substantial proportion of the production from the Crowsnest Pass area was used by the collieries for the manufacture of coke, which was in large part exported. In the earlier years there was some coke production at the Vancouver Island mines, but as soon as the Crowsnest Pass mines came into operation Vancouver Island production of coke fell off and disappeared entirely in 1910. There was some coke production in Vancouver Island during World War I, but production ceased again in 1919.

The following table shows exports of coal for the Province of British Columbia by the principal producing fields, coal used in coke production, coke produced, and coke exported.

COAL EXPORTS, COAL USED IN COKE PRODUCTION COKE PRODUCED AND COKE EXPORTED

(Long tons)

Date	Coal Exports				Coal Used in Coke Production	Coke	
	Total	Vancouver Island	Crowsnest Pass	Inland		Production	Exports
1874	56,038	56,038					
1875	66,392	66,392					
1876	122,329	122,329					
1877	115,381	115,381					
1878	164,682	164,682					
1879	192,096	192,096					
1880	225,849	225,849					
1881	189,323	189,323					
1882	232,411	232,411					
1883	149,567	149,567					
1884	306,478	306,478					
1885	237,797	237,797					
1886	249,205	249,205					
1887	334,839	334,839					
1888	365,714	365,714					
1889	443,675	443,675					
1890	508,270	508,270					
1891	806,479	806,479					
1892	640,579	640,579					
1893	768,917	768,917					
1894	827,642	827,642					
1895	756,334	756,334					
1896	634,238	634,238	...	...	...	1,240	...
1897	619,860	619,860	...	...	...	17,831	2,573
1898	752,863	752,863	...	...	...	35,361	3,205
1899	751,711	751 711	...	...	...	34,251	9,000
1900	914,184	906,215	7,968	...	150,584	85,149	51,757
1901	914,163	841,300	72,863	...	231,226	127,081	47,379
1902	776,809	675,033	101,776	...	244,232	128,015	38,780
1903	549,448	403,438	146,010	...	282,469	165,543	27,758
1904	533,593	415,405	118,188	...	432,070	238,428	100,281
1905	673,700	427,698	246,002	...	441,520	271,785	117,637
1906	679,829	448,966	230,863	...	381,773	199,227	61,704
1907	673,114	381,704	291,410	...	419,541	222,913	60,110
1908	597,157	330,328	266,829	...	431,538	247,399	37,314
1909	741,646	388,217	353,389	40	394,124	258,703	40,478
1910	1,175,099	420,442	751,087	3,570	339,189	218,029	8,730
1911	612,696	400,893	209,894	1,909	104,656	66,005	1,267
1912	967,138	411,830	551,742	3,566	396,905	264,333	50,257
1913	627,515	96,327	527,620	3,568	433,277	286,045	50,626
1914	602,707	210,719	389,383	2,605	355,461	234,577	54,313
1915	658,976	284,230	370,020	4,726	361,451	245,871	24,597
1916	844,045	451,408	386,953	5,684	401,487	267,725	34,377
1917	792,779	553,119	225,847	13,813	248,740	159,905	12,711
1918	811,238	457,048	342,218	11,972	276,479	188,967	17,404
1919	763,990	385,927	373,348	4,715	141,407	91,138	8,134

COAL EXPORTS, COAL USED IN COKE PRODUCTION, COKE PRODUCED AND COKE EXPORTED—concluded

(Long Tons)

Date	Coal Exports				Coal Used in Coke Production	Coke	
	Total	Vancouver Island	Crowsnest Pass	Inland		Production	Exports
1920.........	799,940	316,432	479,342	41,166	101,649	67,792	31,718
1921.........	815,441	291,513	495,331	28,597	85,644	59,434	18,092
1922.........	762,118	356,088	333,451	72,579	69,072	45,835	15,524
1923.........	556,632	156,463	353,725	46,454	89,764	58,919	23,564
1924.........	209,686	118,554	70,674	20,458	48,007	30,615	8,232
1925.........	391,883	141,623	249,436	824	115,770	75,185	21,936
1926.........	293,925	96,409	197,233	283	142,838	93,448	26,296
1927.........	377,564	105,035	271,995	534	129,933	85,072	21,919
1928.........	332,445	89,516	240,023	2,906	92,607	61,370	13,902
1929.........	322,481	89,187	232,217	1,077	103,109	67,280	Not available
1930.........	143,211	65,279	76,752	1,180	98,174	65,810	22,672
1931.........	81,007	37,774	43,023	210	98,411	65,410	16,672
1932.........	59,702	31,757	27,665	280	42,536	29,545	12,855
1933.........	38,345	19,686	18,588	71	8,435	5,444	4,455
1934.........	45,535	22,003	23,532	....	47,894	22,182	6,609
1935.........	54,195	31,104	23,091	....	37,178	24,170	15,563
1936.........	75,435	36,870	38,565	....	11,534	30,370	14,686
1937.........	89,220	46,199	43,018	3	67,634	43,215	24,079
1938.........	91,445	44,045	47,400	....	77,335	48,760	23,531
1939.........	98,705	40,885	57,820	....	78,228	51,205	21,970
1940.........	154,287	79,597	74,690	....	88,418	59,788	21,575
1941.........	122,687	38,055	84,632	....	125,792	83,954	29,737
1942.........	190,994	64,414	126,580	....	128,441	85,555	31,224
1943.........	178,696	24,457	154,239	....	116,485	77,355	35,338
1944.........	210,440	54,197	156,225	18	113,056	75,317	35,334
1945.........	144,691	32,763	111,928	....	89,821	64,774	28,012

Source: Up to 1896 the figures are from Coal Statistics for Canada converted to long tons. From 1896 to 1944, inclusive, they are from annual reports of the British Columbia Department of Mines.

Production in the Province until the turn of the century was based largely on the export market. From about 1890 to 1923 coal exports were fairly stable at approximately 750,000 long tons annually. In the same period annual production increased three-fold, with the result that exports fell from a maximum of 85 per cent of output to about 30 per cent. This decline in importance of the export market is slightly reduced if account is taken of the coal used in the manufacture of exported coke. In 1924 exports declined sharply to some 300,000 long tons annually, with a further severe reduction to some 50,000 long tons annually in the 'thirties. By 1944 exports had risen to over 200,000 long tons.

Vancouver Island exports show a distinct decline from 1900 to 1930, from which time they have ranged from 22,000 to 80,000 long tons annually. The principal factor in this decline was oil competition, particularly following the discovery of new oilfields in California in 1921. Crowsnest Pass exports grew rapidly after 1900, but fell slowly in the early 1920's and sharply at the end of the decade as the Great Northern Railway converted to oil.

YUKON AND NORTHWEST TERRITORIES

There is little to be said regarding the coal mining in the Yukon and Northwest Territories. Production has been limited to a few hundred tons annually for local use.

CHAPTER III

MINING METHODS

The purpose of this chapter is to review the mining methods in use in Canadian coal mines and the experience of the mines in terms of productivity. Productivity is used here to mean the average number of tons of coal produced per day per man employed, or tons per man-day. The financial records of the mines are reviewed elsewhere in the report. An impression of the location and dimensions of the Canadian coal mining industry can be gathered from the following tabulation relating to 1944.

—	No. of Operators	Capital Invested (millions of dollars) 1943	Production (thousands of net tons)	Employment (Wage Earners)	Productivity (Tons per Man-Day)
Nova Scotia	19	46.7	5,746	12,099	1.65
New Brunswick	19	1.4	345	870	1.47
Saskatchewan	89	3.7	1,373	601	8.66
Alberta	196	37.5	7,429	7,665	3.67
British Columbia	26	22.7	2,134	2,650	2.92
Canada	349	111.9	17,027	23,885	2.57

Source: Dominion Bureau of Statistics.

Before reviewing the operations of the mines, it may be helpful to indicate in broad general terms the alternative systems of coal mining and recent trends in mining techniques. It will be realized that coal mining is a highly technical subject and the summary remarks on mining methods are designed only to introduce the reader to the more detailed remarks which appear in the review of the Canadian mines. Again, only the broad principles of the various methods are described. In actual practice many variants of these methods have been developed to meet local conditions.

SYSTEMS OF MINING

A basic distinction in coal mining methods is between underground mining, the traditional method, and strip or open-cut mining in which the coal is dug from an open pit or quarry.

Strip Mining

In recent years there has been an increased adoption of strip mining. This has developed largely as the result of improvements in earth-moving machinery. With the use of heavy machinery it has become economically feasible to recover

coal from open-cut operations at increasingly great depth. Some particulars of the amount of coal mined in this way in Canada in 1945 are as follows:

—	Class of Coal	Net Tons	Percentage of Total Production
New Brunswick	Bituminous	138,792	38
Saskatchewan	Lignite	1,110,340	72
Alberta	Bituminous	473,771	10
	Sub-bituminous	827,820	26
	Total Alberta	1,301,591	17
Canada	Bituminous	612,563	5
	Sub-bituminous	827,820	26
	Lignite	1,110,340	72
	Total Canada	2,550,723	15

High productivity is commonly achieved in strip mining. The highest output per man-day among the Canadian mines is achieved in Saskatchewan in open-cut operations, where the output per man-day is up to 14 tons. Strip mining, however, is necessarily confined to the relatively few areas where the ratio of the overburden to the recoverable coal is low.

Underground Mining

There are two main systems of underground mining aside from underground gasification of coal, the application of which has been limited to the U.S.S.R. These two systems, known as room-and-pillar mining and longwall mining, are both used in Canada. In either system the initial approach to the coal from the surface is either by vertical shaft, by drift, or by slope. Where the coal lies either level with or above the point of entry, the entrance is referred to as a drift. Where the entrance has a downward gradient it is referred to as a slope. From these mine entrances a system of roadways is developed, designed to provide continual access to the coal beds and efficient transportation of men, materials and coal. The roadways are variously referred to as main entries, levels, entries, and cross-entries. The main entries and levels might be likened to the trunk highways, the entries and cross-entries to the secondary roads of the underground transportation system. These roadways are also used as air passages for ventilation. Their pattern will depend on physical conditions and the general plan of the mine.

Room-and-Pillar System

In this system the coal to be worked is divided into blocks by driving entries and cross-entries. Each block is then mined by cutting further entries or "rooms" angling off the cross-entries, coal being left standing between the rooms to support the roof, the strata immediately above the coal seam. The remaining coal, or the pillars, is often recovered in subsequent operations. The width of the rooms, the distances between them, and the thickness of the pillars depend on the character of the roof and floor, the thickness of the seam and the nature and amount of cover (the overburden of rock and earth between the coal and the surface). Generally, larger pillars are required as the depth of mining increases. Rooms are usually from 200 to 400 feet long. Where possible, they are driven to the rise of the coal seam in order to take advantage of gravity for haulage purposes and also to avoid the accumulation of water at the working face, the point at which the coal is actually mined.

Normally a substantial proportion of pillar coal is recovered after most or all of the rooms in the block of coal have been driven to their full length. This "drawing" of the pillars is done usually by a series of cross-cuts driven through the pillar at right angles to the length of the room, the roof of each cross-cut being allowed to cave in after the cut is completed, and a "fender" of coal from two to six feet wide being left standing between each cross-cut. The drawing of each pillar is done according to a program for the whole coal block which is intended to control the "fracture line", or line of caving of the roof. Unless the pillars can be recovered, room-and-pillar mining is wasteful of coal resources. The removal of pillars is generally commenced soon after the completion of the rooms in the block, as with time the pressure of the roof on the pillars tends to increase, with consequent crushing and loss of the pillar coal. The degree of extraction is determined more by economic factors than by physical problems of extraction. Where coals have a high market value and reserves are limited, there will be a high degree of extraction, and where reserves are plentiful and market value is relatively low, some recoverable coal will be left in the pillars if mining regulations permit. For instance, the principal demand on the Drumheller mines is for lump size coal, on which there is a very considerable price premium as compared to prices for the very small sizes. Pillars yield a low proportion of lump coal, so only partial recovery is practical.

A modification of the room-and-pillar system, known as the panel system, is often used in large scale operations. At times it is necessary to seal off sections of the mine to prevent spreading of fires or movements of the roof or floor. In the panel system the areas of the coal which are blocked out for working are surrounded on all sides by barrier walls of solid coal. Throughout the development of entries and roofs and the drawing of the pillars these barriers remain intact except for a minimum number of passages required for haulage and ventilation. In the event of fire the few openings into the panel can be quickly sealed and its influence thereby restricted to a relatively small portion of the mine. Similarly, in the event of a "squeeze" of the roof or floor the strength of the barrier walls or pillars will confine the pressure within the panel.

Longwall System

The distinguishing feature of the longwall system of mining is that the coal is extracted in a single operation, the working face advancing in an unbroken line or wall. The roof is allowed to cave behind the working face, protection being given to the miners working at the face by means of various forms of temporary roof support at the face. The mined-out areas are referred to as the waste or gob. As regards levels and main entries the plan of the mine does not necessarily differ substantially from that of a room-and-pillar mine, although the entries and cross-entries are often driven diagonally instead of on the square to reduce haulage distances.

There are two alternative methods of procedure in longwall mining, namely, longwall advancing and longwall retreating. In longwall advancing the working face starts from the end of the coal block nearest to the mine entrance and advances inward. In longwall retreating narrow entries are driven through the coal to the far boundary and the working face starts at that point, the coal being completely mined as the face is brought back to the point from which the entries were driven. In longwall advancing the waste material is built up in the form of pack-walls as roof support along the side of the roadways. Longwall advancing is sometimes preferred because it provides for early production of coal and thus a quick return on capital invested, and there is some saving in immediate costs through the elimination of the expense of driving and maintaining extended roadways. On the other hand, longwall retreating in some instances has been found to reduce the cost of maintenance of haulage roads as these are abandoned as the coal is removed. The retreating system also tends to facilitate ventilation.

The panel system is often introduced as a modification of the longwall system for the same reasons as in room-and-pillar operations. Another modification known as shortwall mining differs from longwall only in that the working face is shorter.

Longwall mining is widespread in the United Kingdom and in Canada, but the room-and-pillar system is almost invariably practised in the United States. In Canada the longwall system is used for about half the tonnage produced in Nova Scotia, and in some mines in western Canada, but the room-and-pillar system is used in the great majority of mines of western Canada.

The choice between longwall and room-and-pillar mining systems is not a matter of simple rules. The system adopted will usually be the one calculated to achieve the highest possible productivity at the lowest possible cost per ton, consistent with the safety of the workers and recovery of the coal in marketable condition. A great many factors enter into determining which method is superior in any given situation; some of these factors are outlined below.

1. *Roof and Floor*

Roof control is one of the most important factors in underground mining. In general a roof which is sufficiently strong to stand without extensive support in immediate working areas but which will gradually settle after the coal is extracted is desirable. This facilitates a high degree of extraction and the use of mobile machinery. A weak roof requires extensive timbering which, in addition to increasing mining costs, hinders the use of machinery. On the other hand, an excessively strong roof may lead to the accumulation of stresses and the occurrence of "bumps" when these are suddenly released. The phenomenon of bumps is discussed in later pages. The character of the floor is also important. A soft floor often necessitates large pillars and narrow entries in order to withstand the pressure exerted on it through the pillars, and is a handicap in the use of mobile machinery as it is easily disturbed and is thus loaded with the coal. Certain clays which sometimes form the floor expand when soaked with water from seepage in the mine and the consequent swelling may disrupt haulage and other operations.

2. *The Coal*

Thin seams and limited reserves make total extraction important, and mining methods must be directed to this end. Soft friable coal requires larger pillars than a hard compact coal. The pitch and the thickness of the seam also affect the size of the pillars required, haulage, drainage and other working methods.

3. *Gas*

Gases (mainly methane) generally occur in the seam or in the surrounding strata. In many mines these are an operational hazard because in certain circumstances they are explosive. In these circumstances mining methods have to be directed to providing ventilation adequate to safeguard the workers and to permit if possible the use of machinery.

4. *Market*

If the coal is to be coked, preference is given to the mining method which results in the largest possible proportion of slack. If lump coal commands a premium in the market served, that system is preferable which results in the maximum production of large-sized coal. Continuity of demand influences the mining methods used because any temporary closing down through lack of demand may result in the ruin of the working face through the development of roof pressure. In view of the length of the face involved in longwall mining, a fluctuating market would normally suggest the selection of the room-and-pillar system.

5. *Labour*

Any stoppage of work through labour disputes affects longwall mining operations more seriously than room-and-pillar, due to the deterioration of working faces when left standing. Efficient longwall mining is dependent on the team work of much larger groups of men than is room-and-pillar mining. Absenteeism, therefore, or any other instability in the working force available is a deterrent to longwall mining.

It is not desirable at this point to discuss in any detail the relative advantages of the various systems of mining previously referred to. As might be expected, the subject is highly controversial, and the relative advantage of either system in any given locality naturally leads to broad generalizations which cannot be substantiated. It is interesting, however, to note that a highly competent group of British engineers reporting as a Technical Advisory Committee for the United Kingdom Ministry of Fuel and Power[1] on the mining practices followed in Great Britain gave preference to the room-and-pillar system with longwall retreating and longwall advancing as second and third choices. After full consideration, the British engineers determined that the room-and-pillar system, where it could be operated, resulted in greater productivity per man-shift. Where the room-and-pillar system could not be applied, notably where lower seams had been extracted and where reserves were limited and the seams thin, longwall retreating was favoured as against the advancing system, as the advent of new machinery had largely overcome the previous objection to the retreating system by providing for economic driving of entries at speed. In their opinion, it is possible for the longwall retreating system to secure some of the advantages of both the room-and-pillar and the longwall advancing systems; namely, the free exploration and small amount of dead work from room-and-pillar and the full extraction and continuous faces from longwall advancing. In their report, the Advisory Committee summarized the relative advantages and disadvantages of the room-and-pillar system as compared with longwall advancing as follows:

Advantages of room-and-pillar system:

(i) All roadways in the seam are supported by solid coal for as long as they are required, instead of being formed and maintained in the goaf (gob). This results in better and less costly roads.

(ii) Unproductive labour is reduced by the elimination of the packing of the goaf. In thick seams no ripping at all may be necessary, and in the thinner seams less is required than in unsettled ground. Moreover the roadways seldom need subsequent enlargement.

(iii) The proportion of "productive workers" engaged in actual coalgetting operations is increased and, as unproductive labour is reduced to a minimum, a double advantage is secured and a high OMS (Output per man shift) achieved.

(iv) The system is not dependent upon the completion of specific operations by the end of each shift, and the same operations are continued from one working shift to the next.

(v) As there are none of the difficulties associated with the rigid cycle of operations inherent in longwall mining with coalcutters and conveyers, the advantages of multiple-shift getting can be gained.

(vi) As in the case of longwall retreating, the area to be immediately worked is proved, and initial planning may be modified to deal with faults and intrusions without serious loss of output.

(vii) There is evidence that the workers are attracted by the greater variety of the work, and the greater skill required in its performance, once they have become accustomed to the new technique; and the small size of the groups encourages a team spirit.

(viii) The men are grouped in small teams, each of which is engaged on the same series of operations. Supervision and the maintenance of discipline are, therefore, facilitated, and the standard and progress of the work can be readily checked shift by shift.

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[1] See Report of Technical Advisory Committee on Coal Mining, March, 1945, Cmd. 6610.

Disadvantages of room-and-pillar system:

(i) The capital expenditure per ton of output is relatively high.

(ii) The percentage of extraction is usually less than in longwall mining in similar conditions.

(iii) The need for the constant flitting (transference) of machinery from place to place.

(iv) In seams not previously worked by the system, variations in natural conditions make it difficult to be sure that the two successive phases of narrow work and pillar extraction can both be successfully carried through, especially where other seams have been extracted in the same working area.

(v) The use of a large amount of machinery to the best advantage requires a higher standard of planning and organization, and a larger staff of skilled technicians, than are necessary with other intensive systems of mining.

(vi) Subsidence in relation to the surface and other seams cannot be controlled so effectively as in longwall mining.

Mining Techniques

The first method of removing coal from the seam was by pick and shovel. Later, explosives began to be used to break down the coal at the face, the charges being placed in holes bored in the coal with a hand auger. Then tools powered by compressed air were developed for making cuts under, above, or vertically in the coal to improve the effect of explosives, for drilling the shot holes, and for breaking the coal down where, because of gas, explosives could not be used. Most modern equipment is manufactured to use electricity. This applies also to the mechanical loading devices which are now increasingly used in modern mines when conditions permit. Some of these machines almost entirely eliminate the use of the hand shovel. They include mobile and trackmounted loaders and self-loading conveyers, or duckbills, and scrapers. Machines which cut and load are now being introduced.

There are normally four main operations involved in getting the coal from the seam to the haulage system—cutting, drilling, shooting and loading. Unless the coal is soft and breaks easily from the seam, it is undercut either by hand-pick or by machine, sometimes as deep as 8 feet. It may also be cut across the top of the seam and cut vertically or sheared, the latter practice being followed particularly where lump sizes of coal are required. A variety of machines is available which will cut at any level of the coal and either horizontally or vertically. After the cutting operation, holes are drilled at spaced intervals either by hand augers or by power drills. The shot holes are then charged with explosives which are fired either electrically or by fuses according to local mining regulations and safety considerations. In some mines, particularly bituminous mines in Alberta and British Columbia, the use of explosives is prohibited entirely because of the gas hazard. In such mines pneumatic picks or jackhammers are commonly used to break down the coal. When broken down, the coal is loaded by hand shovel (hand loading) or by any of a variety of mechanical devices into mine cars, conveyers, or, in some mines in the mountains, into gravity chutes. These four main operations are carried out as a cycle in the order described. In room-and-pillar mining they may be carried out or repeated in a single shift. Where machinery is used, normal practice is to carry on the operations in a number of rooms in sequence, so that the machinery involved can move from one room to another without delay. In longwall mining the cycle is normally completed in two or three shifts, one loading the coal and the remainder cutting, drilling and shooting the coal, moving tracks or conveyers, timbering and generally preparing for the loading shift.

The transportation of the coal from the face to the surface may be divided into three categories: main, secondary, and gathering haulage. In small collieries these may be consolidated to some extent, but broadly speaking the three stages are the transportation of the coal from the face to the nearest point where

mine cars are gathered, from these points in the entries to the principal roadways where large trains may be assembled, and thence to the tipple at the surface. An important recent trend has been increasing capacity of mine cars: two-ton cars were considered large a few years ago, but in the United States bituminous fields four to six-ton cars are now common. Recently developed drop-bottom mine cars automatically dump their loads at the desired point at the surface, and the train or "trip" is turned back into the mine almost without stopping. A further innovation has been the use of shuttle cars for gathering. These shuttle cars are rubber-tired self-unloading electric trucks, which operate in conjunction with power loaders and form a shuttle system between the face and either the secondary or main haulage. Their chief advantage is flexibility but their use is restricted to fairly thick seams and to gradients of not more than one in eight. The productivity of a loading machine served by shuttle cars is reported to be about twice that of the same loader under other circumstances.

COAL PREPARATION

When coal is brought to the surface from either underground or stripping operations it is commonly "prepared" before being moved to market. Preparation, or beneficiation, may be confined to separation into different sizes and the removal by hand of conspicuous impurities which have been loaded with the coal; processes which are referred to as screening, or sizing, and hand-picking. In some instances screening may include crushing to secure the requisite quantity of smaller sizes. In recent years preparation has increasingly included the reduction of the ash, sulphur and other impurities in the coal by mechanical cleaning. In the case of coal sold for domestic use, preparation may also include spraying the cleaned coal with oil or other materials to make the coal dustless. Cleaning may be accomplished by wet washing or by dry cleaning or by a combination of both methods, the dry cleaning method usually being applied to the smaller sizes as these retain more moisture from washing, and drying is normally an expensive operation.

There is a wide variety of cleaning processes, generally based on specific gravity. The specific gravity of coal varies with its ash and moisture content, but normally its specific gravity is lower than that of the impurities. Cleaning methods commonly seek to separate the coal from its impurities by taking advantage of this difference. In wet washing the coal is immersed in water to which chemicals or other materials have been added to increase its specific gravity to a pre-determined figure in order to allow the coal to float while the heavier impurities sink. In Europe a flotation process is used extensively for coal cleaning. This process operates on the principle that the surfaces of coal are wetted less readily by water than are the surfaces of the impurities. There are a number of variants in the flotation method. It is generally held to be an expensive, although more selective, process. Dry cleaning is based on the principle of specific gravity with air currents replacing water. Air currents rising through perforations in reciprocating screens create a condition in which the coal particles are buoyed up by the air currents while the heavier impurities pass through the screens. In the air-sand process, a bed of dry sand is kept fluid by a continuous upward flow of air thus simulating a dense liquid in which the coal flows and the impurities sink.

Coal preparation has been of increasing importance in recent years for two main reasons. In the first place, increasing competition between coal and other fuels has forced operators to improve the quality of their product. In the second place, the increased use of loading machines in the mines has increased the impurity of the coal as brought to the surface. These machines are less selective and extraneous materials such as sandstone, shale and clay from the roof and floor and possibly partings in the seam are loaded with the coal. Improved preparation, therefore, is practically essential with fully mechanized mining.

It should be emphasized at this point that the impurities with which coal is associated as it comes from the mine are removable only to the extent that they are physically detached from the coal. Finely divided impurities disseminated through the coal substance itself remain largely unaffected by ordinary preparation. The shale, clay, sandstone and bone, which usually form the roof and floor of the coal seam and possibly occur as partings in the seam, and which may become mixed with the coal in mining, frequently constitute the major ash-forming components in coal and can be readily removed in the cleaning process. Pyrite, one of the principal sources of sulphur in coal, and phosphorus are also removable if present as discrete particles.

It is difficult to generalize on the necessity of coal preparation. In each instance, the operator has to weigh the return which he will receive against the additional expense of preparing his coal. The economics of coal preparation are determined by the extent to which the impurity of any particular coal can be reduced and subsequent savings in handling charges and higher market returns secured; the cost of the actual operation including the loss of combustible material during the process; and the pressure of competing fuels including other coals.

PRODUCTIVITY

These recent improvements in face loading and transportation have led to a remarkable increase in productivity where they have been applied. Their implications regarding the selection of mining methods are reviewed in some detail in subsequent discussion of production problems in the Sydney coal field in Nova Scotia. The effects of machine loading and improved haulage systems are most apparent in the high productivity achieved in the United States mines where mechanization is most widespread. Statistics are not available to show the exact effect of improved haulages but the following tabulation for underground bituminous mines in some of the States clearly demonstrates an increase in productivity arising out of machine loading:

TONS PER MAN-DAY, UNDERGROUND MINES, 1944

—	With 90 Per cent or More of Output Mechanically Loaded	With Less than 90 Per cent of Output Mechanically Loaded	With 100 Per cent of Output Loaded by Hand	Total
West Virginia	6.68	5.06	4.44	5.32
Kentucky	7.16	4.28	4.47	4.79
Pennsylvania	5.85	4.62	4.27	4.75
Ohio	6.10	4.55	4.08	5.23
Total U.S. underground bituminous mines	6.60	4.56	4.15	5.04

Of a total United States underground bituminous production of 519,000,000 tons in 1944, about 364,000,000 came from these four States. Of this, 208,000,000 tons came from mines with 90 per cent or more of output mechanically loaded, 158,000,000 from mines with some but less than 90 per cent of output mechanically loaded, and 153,000,000 from mines with all output loaded by hand.

It may be said in general that Canada lags far behind the United States in the extent of mechanization of coal mining. Although power tools are widely used in Canada for undercutting and drilling the coal, the proportion of Canadian coal which is loaded by machinery is very small, and little has been done in Canada to match United States improvements in the capacity and speed of haulage systems. Historically, productivity in the United States bituminous coal fields has been substantially higher than in Canadian fields, and in recent years this

margin has been increased considerably. This difference between the United States and Canadian trends in productivity, illustrated in the following table, has resulted in a deterioration of the already difficult competitive position of many Canadian coals in Canadian markets reached by United States coals.

TONS PER MAN-DAY, ALL WAGE EARNERS

Some Canadian Coal Fields

—	1934	1939	1944
Cape Breton, N.S.	2.54	2.60	1.73
New Brunswick	1.33	1.42	1.47
Saskatchewan	5.12	5.85	8.66
Drumheller, Alta	3.73	3.94	3.58
Coalspur, Alta	4.44	4.49	4.00
Mountain Park, Alta	3.75	3.71	3.87
Cascade, Alta	3.09	3.21	4.34
Crowsnest, Alta	3.07	3.84	3.67
Crowsnest, B.C.	3.97	4.38	4.23
Vancouver Island, B.C.	1.82	1.84	2.03

STATES PRODUCING BITUMINOUS COAL
WHICH COMPETES IN CANADIAN MARKETS

—	1934	1939	1944
West Virginia	4.73	5.51	5.61
Kentucky	4.33	4.68	5.08
Pennsylvania	3.98	4.77	5.28
Ohio	4.23	5.35	6.77

It should be noted that the United States mines which ship to the Canadian market usually achieve a higher productivity than the average for the States in which they operate. In practice, therefore, the above comparison is an understatement.

It is generally recognized that physical conditions in the United States, notably in the central coal field where mechanization has been most widely adopted, are very favourable. Moreover the machinery has been developed to suit these conditions and is not readily adaptable to other conditions; it is more costly to the Canadian operators owing to customs duties. In the review of the Canadian mines which follows, the extent to which mechanized mining can be extended is discussed.

NOVA SCOTIA

Nova Scotia mines produced 5,745,671 tons of coal in 1944 as compared with 7,256,954 tons in 1937. Approximately 87 per cent of this total was produced by subsidiary companies of the Dominion Steel and Coal Corporation, Limited (Dosco), the remaining tonnage being the output of some 10 small independent companies, most of whom are members of the Independent Coal Operators' Association of Nova Scotia. Coal mining in Nova Scotia is almost entirely confined to underground mining, a large percentage of the tonnage coming from submarine operations. Of the 1944 tonnage, 4,319,083 tons were produced on Cape Breton Island. The remainder was produced on the mainland, 880,799 tons coming from the Cumberland coal fields and 545,789 from the Pictou coal field.

Cape Breton Island

Coal production in Cape Breton Island is concentrated in the Sydney coal field. A number of small mines, the principal of which are owned by the Provincial Government at Inverness, operate on the west coast. These account for only 93,400 tons out of the total of 4,319,083 tons produced on the island in 1944. Two large operating companies, the Dominion Coal Company Limited and Old Sydney Collieries Limited, subsidiaries of Dosco, account for over 90 per cent of the total production in the Sydney coal field. The remainder is produced by three small independent operations, which in 1944 produced in aggregate 181,793 tons. The production of the various companies in the Sydney coal field in 1944 was as follows:

Dominion Coal Company Limited	3,361,043
Old Sydney Collieries Limited	682,847
Bras d'Or Coal Company Limited	136,972
Indian Cove Coal Company Limited	31,375
Sullivan Coal Company Limited	13,446

The location of the various mines in the Sydney coal field is indicated on Map 4 appearing in the chapter on Coal Reserves. It will be noted that eight of these collieries are located in the Glace Bay district, three in the New Waterford district, and seven in the Sydney Mines district, north of Sydney Harbour. These mines work six of the twelve coal seams in the Sydney coal field—namely, in descending order, the Harbour, Bouthillier, Phalen, Indian Cove, Emery and Gardner seams. The land areas in the Harbour, Phalen and Emery seams have been largely worked out. A large proportion of the production comes from the Harbour and Phalen seams, which range in average thickness from 5 to 6 and 5.5 to 7.5 feet respectively. The other seams are not as thick or as consistent.

All of the seams dip to the northeast under the sea at about 16 per cent, although gradients as high as 38 per cent are encountered in the workings on anticlinal limbs of the four basins into which folding has divided the field. The strata intervals between them are consistent and sufficient to allow for separate mining of the seams or ultimate connection with other seams by horizontal cross-measure tunnelling. Generally the roof is a weak shale but local areas of sandstone roof occur. The floor varies from a soft fire-clay to hard shale. The coal is of high volatile "A" bituminous rank, and the mines are generally gassy. There is a considerable variation in the quality of coal between seams and areas. The coal has a moderately low ash content and medium to high sulphur content. Calorific values on an as-received basis range from 11,800 to 14,200 B.t.u./lb. The fusion point of ash of the coal is low.

Systematic mining was first undertaken in this field in 1825, although some extraction of coal from outcrops along the coast had been carried on from the time of the earliest settlements. Two of the mines presently operating were opened about seventy-five years ago and a number of the mines are now nearly 50 years old. A number of the hoisting slopes and shafts put down at that time are still in service. The first organized mining efforts were confined to the land area, but over forty years ago the workings penetrated into submarine territory. At the present time nearly 90 per cent of the Dominion Coal Company output and 100 per cent of Old Sydney Collieries production comes from submarine operations. The independent companies largely confine their operations to land areas.

Dosco Companies

The Dominion Coal Company operates eleven mines, eight of which are in the Glace Bay district and three in the New Waterford district. Three of those in the Glace Bay district and one in the New Waterford district are slope mines, the remaining five mines in the Glace Bay district are served by three shafts;

in two instances horizontal cross-measure tunnels having been driven from original workings on the Phalen seam to provide convenient access to the overlying Harbour seam. The workings of these mines are confined to the Harbour, Phalen, Emery and Gardner seams, the largest percentage of production coming from the Harbour and Phalen seams. Old Sydney Collieries operates two mines in the Sydney Mines district. Princess mine, which produces 60 per cent of the company's production, is a shaft mine, whereas Florence colliery is a slope mine. Both collieries work the Harbour seam in the submarine area. Within recent months a strip mine, which will produce 500 tons per day, was opened by that company on the Lloyd Cove seam.

Until about twenty years ago the room-and-pillar system of mining was universally used throughout in these mines but about 1926 physical conditions became so severe in some working sections that it was impossible to win the pillar coal. Accordingly, the longwall system was introduced, the present methods being evolved after a great deal of experimentation and the development of trained crews. At the present time both mines of Old Sydney Collieries operate on the longwall system. The Dominion Coal Company secures 60 per cent of its output from room-and-pillar operations, the remainder coming from longwall mining. Some of the mines use both methods.

In the room-and-pillar system, as carried on in these mines, rooms are usually driven on the strike of the seam. In a number of instances, however, rooms are driven on a slightly rising grade to facilitate haulage. The coal is generally undercut by air-driven radialax machines and bored by air-driven jackhammers. In two cases, however, where the mines are damp, the coal is undercut by electrically-driven shortwall coal cutters. In all cases, coal is loaded by hand into mine cars placed directly at the working face. In many instances in the submarine areas the pillars formed by the driving of the rooms are not drawn but are left in place to support the roof and prevent the infiltration of water from the sea. Where the work is carried on below 800 feet of solid cover pillars are drawn and where physical conditions will permit complete extraction is achieved.

The longwall operations as carried on in these mines are nearly all longwall advancing. Longwall retreating methods were experimented with exhaustively at an earlier date, and it was definitely established that with little exception longwall advancing methods were more economical under the physical conditions of the Sydney coal field. In particular, the weak nature of the roof and pavement necessitated extensive maintenance of the roads developed in the solid. In longwall operations, as practised in the field, faces from 250 to 500 feet in length are developed. They are usually advanced on the strike. In the most recent workings several walls are advanced together, so that they form an uninterrupted face line extending for a length of as much as 1,600 feet. This has the advantage of reducing the cost of roadway construction and maintenance. The faces are protected by 12-foot wide stone mid-walls built on 50-foot centres, and the immediate face is supported by hardwood chocks built close to the face. These chocks are drawn as the walls advance, permitting the gob between the mid-walls to cave. Roadways are protected by stone packs, generally 17 feet in width, and in some cases a double packing system has been used. The coal on the faces is undercut by compressed-air-driven longwall machines to a depth of either 4.5 or 6 feet. Drilling is done by compressed-air-operated jackhammers. The coal is hand-loaded on shaking conveyers and conveyed to the haulage road at the bottom of the longwall face where it is either discharged into mine cars

or on to a 30-inch belt conveyer for transfer to mine cars at constructed loading points. In some cases it is necessary to support the roads through the longwall wastes with steel arches.

In 1945 the Dosco companies in the Sydney field employed 8,131 men at the mines, as compared with 8,764 in 1939. Of the 1945 force, Dominion Coal Company employed 7,152 and Old Sydney Collieries 1,285. Production per-man-day figures covering 1945 and 1939 for the two companies were as follows:

—	Mining Labour		Underground Datal		Total	
	1939	1945	1939	1945	1939	1945
Dominion Coal Company	7.6	5.7	5.3	2.8	2.7	1.6
Old Sydney Collieries	5.0	5.3	4.8	4.1	2.1	1.9

Independent Companies

The independent companies operate five mines in the Sydney coal field, all of which are located in the Sydney Mines district. All the companies operate on sub-leases from Dosco subsidiary companies. The Bras d'Or Company has two mines, the Toronto or Colonial No. 1 mine operating on the Phalen (Collins) seam, and the Franklin mine operating on the Bouthillier (Edwards) seam. The Indian Cove Coal Company also has two mines, the Greener mine and the Tomson mine, which operate in the Back Pit (Indian Cove) seam which lies immediately above the Phalen seam. The Sullivan mine, which is operated under common management with the Indian Cove mines, also works the Back Pit seam.

Room-and-pillar methods are used in all of the mines, and mechanization is limited, being confined largely to the Franklin mine where standard electric undercutting machines with electrically-driven shaking conveyers, duckbills and drills for shot-hole boring are used. The Franklin mine has a screening plant which is adapted for making fine sizes for stoker fuel and for dustless preparation of such sizes.

About 400 men are employed in these operations, some 280 of whom are employed by the Bras d'Or Coal Company. Production per-man-day averages between 1.5 and 1.6 tons in these mines.

Present Productivity

It will be noted from the production records of the Dosco companies that there has been a serious decline in overall per-man-day production since 1939. The figures for the Dominion Coal Company show production in 1945 was 1.6 as compared with 2.7 tons per man in 1939. Those for Old Sydney Collieries show a decline from 2.1 in 1939 to 1.9 in 1945. This decline has seriously impaired the position of Sydney coal in competitive markets. We are advised that the primary factors leading to this recent trend in productivity are:

(1) A lack of balance between producers and non-producers,

(2) Abnormal absenteeism,

(3) Unsatisfactory industrial relations.

The following statistics supplied by the Dominion Coal Company indicate the fluctuations in the balance between producers and non-producers in the company's mines from 1939 to 1946:

Working Force	1939	1941	1943	1944	1945	1946 (To Sept. 30)	1946 (October)
Surface datal	915	938	931	981	966	992	996
Underground datal	3,566	3,591	3,570	3,803	3,846	3,950	3,918
Mining labour	2,740	2,289	1,966	2,080	2,037	2,210	2,350
Total labour	7,221	6,818	6,467	6,864	6,846	7,152	7,264

It is apparent from the table that the initial imbalance arose out of a decline in the number of producers, or mining labour. This shortage arose out of enlistments and attraction to other employment. By 1941 the number of producers had been reduced by 450. Following this, efforts were made by government agencies, including National Selective Service, to assist in correcting this position. These efforts included freezing the workers to the mines, provision for compulsory transfer of qualified miners from other employment, and their return on special leave from the Armed Forces. In co-operation with the provinces, the qualification requirements governing working at the face were modified and training schemes, supplementary to those of the operators, were implemented. These efforts by 1944 seem to have offset to a limited extent a low of 1,966 producers in 1943 but a shortage of 703 is still apparent in the 1945 figures and in October, 1946, the figure is 390 short of the 1939 position.

The figures also indicate that until 1943 the number of non-producers remained fairly constant, a slight increase in the number of these men being recorded. By 1944 a substantial increase in the number of non-producers is apparent, and this trend has been continued into 1946. Thus, in October 1946 the company employed 433 more non-producers than in 1939. To further illustrate, the percentage of mining labour to the total force in 1939 was approximately 38 per cent; in 1946 the percentage has decreased to approximately 32 per cent. Various reasons have been given for the increased number of datal men employed since 1943, the more recent trend being attributed to the return of men from the services. During recent months the figures include about 150 underground datal men who are attending mining apprenticeship classes.

The actual shortage of producers recorded above was aggravated by abnormal absenteeism. The following statistics were supplied by the Dominion Coal Company from their records of absenteeism among their mine employees for the years 1943 to 1946:

—	1943 Per cent	1944 Per cent	1945 Per cent	1946 (To Sept. 30) Per cent
Surface force	11.95	14.25	16.11	17.99
Underground datal	18.21	22.64	25.55	27.41
Mining labour	23.51	27.26	33.98	35.46
All employees	18.88	22.65	26.58	28.34

It will be noted that absenteeism of all classes of labour in 1946 was 50 per cent greater than in 1943, and we are advised that in that year it was considerably above the normal peacetime average. It will also be noted that the percentage of absenteeism was highest among the producers. This in particular affected production as, in addition to the direct loss of output, it aggravated

the imbalance between producers and datal men noted above. The shortage of producers experienced by the Dominion Coal Company was not acutely felt by Old Sydney Collieries. The records of the company, however, show that absenteeism was equally prevalent and followed the same pattern.

Some discussion of absenteeism and relations between the mine workers and the operators appears in the chapter on Industrial Relations. At this point, it is noted that the decline in productivity since 1939 is unrelated to technical mining problems and that the restoration to the 1939 level of productivity appears to hinge on correcting the imbalance of the labour force and securing steady attendance at work and more satisfactory labour-management relations.

Necessary Productivity

As previously noted, the United States mines have achieved in recent years a remarkable record of productivity. As a result of this, even if the mines in the Sydney area recover their pre-war productivity of 2.5 tons per man, this achievement probably will not be sufficient to allow them to retain their pre-war position in competitive markets. The records achieved by the United States mines have been brought about by the development of room-and-pillar methods of work coupled with the development of electrically-operated coal cutters and loading machines and conveying equipment of various types. The use of such methods and equipment permits the production of large outputs from relatively small areas. The concentration of the active working sections of the mine in comparatively small areas reduces difficulties of ventilation and thus facilitates the free use of electricity at the working faces. It also reduces to a minimum the transport system of the mine, with the result that haulage costs are cut in respect to both operating and maintenance charges. The rapid working of areas made possible by the use of the machinery lowers maintenance costs generally, including labour and materials costs, since the coal from the area may be entirely removed before roof control becomes troublesome.

United States experience in the use of these techniques has been that the general morale of the mine workers has been very much higher than under the old system, as most of the drudgery and monotony traditionally associated with the coal industry has been removed with the use of machinery. The system also permits close supervision within the working sections and has proved conducive to the development of team spirit, an essential factor in successful mining operations. Moreover, the adoption of datal pay, which is generally recognized as integral to the successful introduction of these new techniques, has eliminated grievances which had been very prevalent under the contract system of payment.

Operating conditions in the United States central coal fields are exceptional, and undoubtedly favourable conditions partially explain the remarkable records achieved. Before discussing the possible application of United States mining methods in the mines of the Sydney coal field, it is therefore pertinent to compare the operating conditions of the two areas.

The physical conditions of the central coal fields of the United States include flat seams lying under land areas, good roof and floor measures, and shallow cover. By contrast, the seams of the Sydney coal field are pitching and are for the most part submarine, the roof and floor measures are weak, and the workings are under heavy cover.

In the flat-lying American seams entries can be made by shaft or slope almost at will, and the distance from the workings to the surface thus reduced as it is deemed necessary. Haulage from gathering points in the workings can be accomplished by the use of fast-moving locomotives and large mine cars. Gathering locomotives, or equipment serving the same purpose, can rapidly and cheaply assemble the coal from the working faces to those gathering

points. The submarine extension of the Sydney coal field necessarily involves increasing haulage distances as the submarine workings project further from the entries at points near the shoreline and there is no ready relief from this situation. The following tabulation showing the seaward extension and depth of workings of the Dosco mines indicates the proportions of the problems encountered.

Colliery	Distance from Shoreline	Distance from Entry	Elevation below Sea Level
	(Miles)	(Miles)	(Feet)
No. 1B	3.7	3.9	1,730
No. 2	2.9	3.6	1,900
No. 4	2.7	3.8	1,680
No. 12	1.4	2.0	2,290
No. 16	1.1	2.0	2,150
No. 20*	2.0	2.7	1,150
No. 24	0.3	1.9	880
No. 26†	2.4	2.6	590
Princess	2.6	2.8	1,780
Florence	2.5	3.2	1,400

* Tunnelled from No. 2 Colliery.
† Tunnelled from No. 1B Colliery.

The dip of the seams in the Sydney field gives rise generally to gradients beyond the limit of 4 per cent where locomotives are serviceable. Electric trolley locomotives are used in mines Nos. 25, 26, 40 and 1B (main haulage) but as the average grade of the field is about 16 per cent, with pitches up to 38 per cent occurring in some localities, rope haulage is generally adopted. There are 33 miles of main rope haulages and a further 5·5 miles of relay rope haulages, the latter occurring in 4 collieries where relays have been required to divide the haulage effort over extended distances. Gathering the coal from the working faces to assembly points is accomplished by rope haulage or, in some instances, by hand-pushing or by horses.

The good roof and floor existing in American mines permit working with a minimum of roof support and roadway maintenance. As close timbering is not required, heavy equipment is manoeuverable. In the Sydney field, the weak roof and floor requires close timbering and costly construction and maintenance of main roads. The close timbering required in most of the working sections restricts the choice of working methods and generally prohibits the use of shuttle cars and the larger units of loading equipment used in some of the United States mines.

The shallow cover obtaining in American mines permits ease of roof control. It also permits the sinking of ventilation shafts at convenient points so that, with relative ease, ample ventilation can be supplied to all parts of the mine with the result that electricity can be safely and conveniently used for all purposes. Disposal of water can be easily accomplished from any point in the workings, since the head against which it has to be pumped is comparatively light. In the Sydney field heavy covers, averaging 1,440 feet and with a maximum of 2,250 feet, cause major problems of roof control and necessitate heavy expenditures for construction and maintenance of support. Ventilation currents must be conducted from entries near the shore to the working places and returned to land exits. There are about 160 miles of constructed and maintained airways in the 13 collieries of the Dosco companies. In one mine, the ventilating currents course as much as 11·9 miles underground. Over 1,100,000 cubic feet of air per minute are forced through the workings of the collieries by electrically-operated fans powered by motors totalling 2,500 horse-power. In several collieries booster fans have had to be installed underground in order to avoid too high ventilating

pressures at any point. While the ventilation is ample for some purposes, it has been generally considered inadequate to permit the use of electricity in the vicinity of the working faces and, as a consequence, the more expensive and less efficient compressed air is generally used underground for motive power. To provide this motive power, compressors having a total capacity of 75,000 cubic feet of air per minute, of which 82 per cent is compressed electrically, have been installed. All main haulages and many of the subsidiary hoists are electrically operated, as well as all main pumps. Some conveying equipment outside the working faces and coal cutters in two of the smaller mines where the workings are damp are powered by electricity. The remainder of the electric energy used is consumed on the surface for the driving of compressors, fans, hoists and auxiliary equipment. The use of electricity has increased from 4·75 kilowatt-hours per ton of coal hoisted in 1913 to 25·5 kilowatt-hours in 1944.

Owing to the depth of the mines in the Sydney field, the disposal of water is somewhat more difficult and more costly than it is from the shallow mines in the United States. These submarine mines, however, are remarkably dry, most of the water coming from the old land workings. This is accumulated near the shore-line in lodgments built for the purpose and pumped to the surface without reaching the working sections. The water pumped amounts to 2½ tons per ton of coal hoisted.

The Dosco companies carried on some experimental work with the use of a duckbill loader from 1928 to 1932, but physical conditions in the field and the stage to which the duckbill had been developed at that time were such that no advantage accrued from the use of this equipment. During the same period a re-allocation plan was developed whereby some of the collieries were to be discontinued as producers and sea frontages in whole or in part redistributed to neighbouring collieries to afford the latter greater lateral development. In this way, coal formerly allocated to two collieries could be drawn through the main haulage of one and the roadways of abandoned collieries used for airways for the continuing mine. The plan included developing overlying seams through cross-measure tunnels driven from points approximately 1.5 miles from the shore in existing collieries. When No. 20 colliery was being developed from No. 2 colliery in 1938, the Dominion Coal Company obtained from the United States mobile undercutters and loaders and electrically-driven flight conveyers. Trial runs indicated that the machinery was suitable but the mine workers refused to work the machinery, apparently from fear of a general displacement of labour arising out of general mechanization, and after the mine had been idle for some ten months the equipment was withdrawn.

During the Commission's enquiry, three eminent American engineers have inspected the Dosco mines in the Sydney field, one at the request of the Dominion Coal Company. It is apparent from their reports and from our conversations with Dosco engineers that, from a technical point of view, the United States mining methods can be applied to advantage in at least some of the mines in the Sydney field. The engineers are mutually agreed that with the use of United States equipment the rate of extraction of the coal in any given area will be sufficiently rapid to overcome the conditions which existed in room-and-pillar mining with hand-loading and which forced an extensive adoption of the less desirable longwall system of work, and permit a return to the room-and-pillar system in a number of the mines. The introduction of mechanized loading in some of the mines presently operating under the room-and-pillar system is thought to offer the possibility of gradually improved productivity. We are advised that the adoption of mechanized room-and-pillar mining will result not only in increased productivity of the face workers but in a most material concentration of the workings of the mines. This concentration of workings should permit a substantial reduction of the number of subsidiary haulages required to service the workings of any colliery in which the equipment is installed. This

should lead not only to a saving in labour cost but to a very material saving in the maintenance of the roadways because of the shorter total length of roadways required. The concentration of workings should permit a more adequate ventilation without larger quantities of air being forced into the mine as the ventilation available would be directed through fewer working areas. This should permit the general use of electricity throughout the mine and an abandonment of the use of compressed air, with a consequent saving in power costs. In general, in those mines where mechanized room-and-pillar methods can be applied, the overall as well as the producer productivity should be improved and a general reduction in labour, material, maintenance and power costs secured.

The companies have informed the Commission of the plans they have recently developed for the introduction of total mechanization in the immediate future into certain of their mines where conditions are most favourable for its adoption. It may be appropriate to illustrate these proposals by reference to specific mines. Old Sydney Collieries has taken initial steps for the conversion of Princess mine to mechanized room-and-pillar, having ordered certain equipment and received the order in part. This equipment consists of a caterpillar-mounted arc shearing machine, a mobile loading machine, fast boring electric drills, 15-inch flight conveyers for the conveying of the coal in the rooms and cross-cuts, a 30-inch belt conveyer for the headway, and the necessary electric control equipment. The company intends to use this equipment to develop the entries which will be required for the return to a room-and-pillar system. When this development is completed, it is proposed to drive 16-foot wide rooms in series of three for a distance of 300 feet from the entries, and then to immediately draw the pillars formed by the room development. The success of the method will depend almost entirely on the speed with which the workings can be advanced and the pillars withdrawn. The coal from the working section will be delivered by conveyers into mine cars on the level entry, and these will be transported to the main haulage of the colliery in the initial stages of the work by rope haulage, but later on as the level entry is extended the Company proposes to replace this rope haulage by diesel locomotives. At the present time the output of the mine is produced from six working levels. When the conversion to mechanized room-and-pillar is completed, the same output will be obtained from two operating levels.

A somewhat similar installation is contemplated for No. 25 colliery of the Dominion Coal Company, but in this case roof and pavement conditions are much better and the gradient is more gentle than in Princess colliery. For these reasons the Company thinks it will be possible in No. 25 colliery to drive wider rooms without excessively close timbering, thus permitting the use of storage-battery shuttle cars instead of the flight conveyers to be used in the rooms of Princess colliery.

As previously noted, United States mechanized room-and-pillar methods may not be applicable to all areas in the Sydney coal field owing to the severity of physical conditions, and it would appear at the present time that operations in some of the mines may have to continue on the present basis. The question of possible improvements in regard to longwall operations is discussed later. Presently the Dominion Coal Company anticipates that within the period of the next five years 40 per cent of its output or over 7,000 tons of its daily output will be obtained from totally mechanized mines. The Company estimates that the productivity of these mines will be increased to 5 tons per man-day and, with the return to pre-war productivity in the other mines, the overall unit production will be 3.5 tons per man-day on an 18,000 tons daily output. The Company considers that this program will cost about $2,500,000, excluding the necessary outlay for a preparation plant. Old Sydney Collieries believes that its two mines can be totally mechanized and that their productivity can be raised to 5 tons per man-day. The Company's plans anticipate that this will be accomplished within a period of five years at a cost of a little over $1,000,000 excluding provision for preparation.

We are advised that the beneficial results of such a program cannot be achieved in a period much less than the five-year interval included in the plans of the companies. Extensive experimentation is involved and crews have to be trained in the new techniques and to handle the machinery.

Some indication has been given of improved haulage which will accrue from the adoption of mechanized room-and-pillar mining. This improvement, however, will be very limited. Owing to the heavy gradients in the mines, the use of rope haulage will have to be continued and this form of transportation has serious limitations. Moreover, mechanization will be applied to mines which already have established roadways. In these mines track gauges vary between 26 and 36 inches and the mine cars are small, averaging less than 2 tons in capacity. A considerable capital outlay would be necessary to effect a radical changeover to heavy equipment, adequate returns on which are questionable. It remains, therefore, that the haulage performance in the mines in the Sydney coal field cannot be expected to achieve the records in the flat seams in the competitive mines of the United States. No accurate statistics of the man-day production per haulage worker in the Dosco mines are available but we are advised that 10 tons per haulage worker would be a reasonable approximation. This compares with an average of 50 tons per haulage worker for all United States mines, much higher figures being attained in some of the mines competitive with Nova Scotia mines. Moreover, the limited possibilities of materially improving the transportation system in the mines in the Sydney field leaves unaffected the serious loss of time experienced in transferring the men to and from the working faces. As an average for all the mines 1 hour and 50 minutes per man per day is lost in this process. We are advised that the companies are actively directing attention to the matter of installing faster moving man-rakes and their extension as far as is practical in the mines.

It is inevitable that some displacement of labour will accrue from the foregoing plans for the adoption of mechanized room-and-pillar methods for these plans do not include an increase in the overall production of the Sydney field beyond the normal capacity of existing mines. Increased production per man-day, therefore, will necessarily mean that eventually the output will be secured from a smaller labour force. It is not possible at this time to estimate the extent of this displacement as it will take place over a period of time. Some of the men displaced will be of pensionable age, and a proportion of these will be eligible for pensions under the companies' pension plans. Natural wastage will also reduce the number of men affected. However, displacement will present a difficult problem in the community. The alternative, however, is even more serious as the industry cannot continue on the present level of productivity. This has been increasingly recognized by the mine workers in the area.

It has been indicated that some mines in the Sydney coal field may have to continue with longwall methods. As there is very little longwall mining done on this continent except in Cape Breton, it is natural to find that latest improvements exist in the United Kingdom and Europe where much longwall mining is practised. In England electrically-operated combined cutting, shearing and loading machines are in use, and it is possible that these could be adapted for use under Cape Breton conditions. There is also the possibility that where the pitch is not too steep, mobile loading machines may be used. The introduction of any such machinery into the Cape Breton longwalls must be preceded by serious study of the improvements recently achieved elsewhere, and will involve exhaustive experimentation. We are of the opinion that this should be proceeded with, but we wish to emphasize that, inasmuch as the productivity from longwall operations will not reach the level of mechanized room-and-pillar methods, every effort be extended to adapt the room-and-pillar techniques to areas where it is at all possible.

Preparation Plants

Preparation of coal for the market at the Dosco collieries is limited at the present time to screening and hand-picking. Generally only lump and slack sizes are made, but in some cases a limited amount of nut coal for stoker use is made. Further sizing is done at storage piles at Montreal where large stocks of coal are stored for distribution in the central Canadian area. Coal supplied to the Dosco steel plant at Sydney and the LaSalle coke plant in Montreal is crushed and washed in a Baum washery at the steel plant.

The introduction of mechanical loading in the collieries will inevitably necessitate the provision of more adequate preparation plants. Inherent in this type of mining is an increased impurity content in the coal as loaded and, in order to maintain the quality of their products, the companies will have to adopt large scale preparation, including washing and possibly dustless preparation for domestic sizes. Assuming that the fine sizes below $\frac{1}{4}$ inch would not have to be cleaned, and that heat drying would be unnecessary, we are advised that it would be possible to build a suitable plant at a cost of $1,000 to $1,500 per ton of hourly capacity. To provide such cleaning facilities for the Dosco mines would probably require an expenditure of approximately $2,000,000.

Deep Shaft

It has been suggested that eventually the continued extension seawards of the present mines will become impracticable, mainly because of haulage and ventilation difficulties. The remote submarine areas, it was intimated, may then be mined from shafts 2,500 to 3,000 feet in depth sunk near the coastline, from which level tunnels would be driven through the rock to tap the seams four to five miles from the shoreline. Transport through the level tunnels would be by heavy electric locomotives, thus facilitating the rapid movement of production, materials and men.

Mining of a somewhat comparable nature has been developed in the State mines of Holland but, before it could be adopted on the much larger scale and under the different conditions of the Sydney coal field, an intensive engineering study over a period of years would be necessary. The capital cost of such a project would run into many millions of dollars.

Mainland

Production on the mainland of Nova Scotia is concentrated in the Pictou and Cumberland coal fields; although small scale mines have operated intermittently in the Kemptown area in Colchester County. As previously noted, 545,789 tons were produced from the Pictou coal field in 1944 and 880,799 tons from the Cumberland coal fields.

Pictou Coal Field

Three companies operate in the Pictou coal field, namely, the Acadia Coal Company Limited, the Intercolonial Coal Company Limited and the Greenwood Coal Company Limited. As will be seen from the following production figures, the major operator in the field is the Acadia Coal Company, a subsidiary of Dosco.

—	1944	1937
Acadia Coal Company	353,557	485,564
Intercolonial Coal Company	161,026	230,969
Greenwood Coal Company	31,206	52,894

Acadia Coal Company Limited

The Acadia Coal Company operates two slope mines and one shaft mine in the Stellarton area of the field, and, at the time of writing, is opening a new operation in the Thorburn area. The active mines operate on the Foord, Cage, Third, McGregor and Acadia No. 1 seams.

Mining conditions are most difficult in the Pictou coal field because of a number of factors. Arising out of the drift origin of the deposit, wide variations exist in the thickness and characteristics of the seams and the coal is liable to spontaneous heating. Following the deposition of the seams, extensive folding and faulting took place causing irregular dips and the actual displacement of the seams at comparatively short intervals. This condition is most prevalent in the central Stellarton area. The roof and pavement strata consist of extremely weak shales, so that even under comparatively shallow cover roadway maintenance is costly. The seams are thick, varying from 6 to 40 feet, and in some cases even the latter thickness is exceeded locally, probably due to earth movements subsequent to deposition. The coals in this field are liable to spontaneous heating, particularly in the underground wastes, necessitating carefully selected methods of work and special precautions to prevent outbreaks of fire.

The coal generally is classified as high volatile "A" bituminous, although some of it in the Westville area ranks as medium volatile. In general the coals range from low to medium sulphur content and medium to high ash content. The ash fusion temperatures range from 2,350 to 2,450 degrees, and calorific values from 11,230 to 12,600 B.t.u./lb.

The general method of mining in use is a room-and-pillar system, but because of the liability to spontaneous heating, work is carried on in a panel system. Experience has shown that these panels should not exceed an area greater than 500 feet long and 400 feet wide. Each panel is left surrounded by a fire barrier of solid coal at least 50 feet in thickness. As soon as the rooms in any panel have been driven, the pillars are extracted. As pillar drawing proceeds, great care must be exercised to prevent the presence of oxygen in the extracted area. The waste area is therefore kept under a gas blanket mainly consisting of methane to exclude the oxygen, and it is only by this practice that the fire hazard may be controlled. The entries to any panel are kept to a minimum because when the area is worked out the entries must be sealed and the whole panel placed under a gas blanket. In general, in this system of work the coal is cut by compressed-air-driven radialax machines, and bored by compressed-air-driven jackhammers, although in some cases the coal is cut by hand picks where its nature is such that this can be done to advantage. Coal is loaded by hand into mine cars at the working face, the average capacity of which is a little over one ton.

A small proportion of the output is won by longwall methods. Longwall advancing methods are used as the retreating system proved less satisfactory and more expensive. Longwall is worked wherever conditions will permit because maintenance required in the room-and-pillar method is more costly, as with the longwall method a much larger output can be obtained per foot of roadway driven. Walls are generally two hundred feet in length and operations generally are comparable to the system employed in the Sydney coal field. In the Pictou field, however, extreme care must be exercised in the building of roadside packs in order to prevent spontaneous heating in the longwall waste. The longwall faces are undercut to a depth of 5 feet by compressed-air-driven longwall machines, and are bored by compressed-air-driven jack hammers. Where the gradient is less than 25 degrees, the coal is loaded by hand on shaking conveyers. Where it exceeds 25 degrees, flat sheets are used to transport the coal along the face to the landings where the coal is loaded into mine cars. The average distance from the entry to the working faces in these mines is about 6,000 feet.

Disturbed physcial conditions, however, necessitate many transfers in bringing the coal from the working faces to the surface. Haulage is by rope, in most cases driven by compressed-air-operated engines. Great care must be exercised in controlling the ventilation within working sections in order to minimize the hazard of spontaneous heating and to assist in doing this, air pressures across a working section are kept to a minimum and cross-circuits across totally extracted areas are avoided. Three of the ventilating fans of the Company are operated by electricity, and one is steam driven, steam power being particularly suited for a variable speed control.

The Acadia Coal Company employs currently some 1,300 men. Production per man-day figures for the years 1939 and 1944 are as follows:

—	Mining Labour	Underground Datal	Total
1939	5.3	3.5	1.6
1944	5.6	2.0	1.2

The causes of the decline in productivity since 1939 in this instance are similar to those discussed in the Sydney coal field. Because of the physical conditions existing in the Stellarton area, mechanized room-and-pillar methods cannot be applied in these mines. However, some experimental work has been carried on with a compressed-air-operated loading machine of the rocker-shovel type, and we are advised that this promises to yield a much better productivity where it can be installed.

The Company is at this time engaged in opening a new mine in the Thorburn district which lies in the eastern part of the coal field. In this area physical conditions are very much better than those which exist in the Stellarton area, and it is proposed to employ United States methods throughout the operation, except in a few small areas where the inclination of the seam is too steep to permit their application. The McBean seam which will be mined pitches at 21 degrees at the surface but gradually flattens at depth. Main haulage will, therefore, have to be of the rope type but diesel locomotives will be used for subsidiary haulage. The main motive power to be used in this colliery will be electricity. The colliery, when completed in the latter part of the summer of 1947, will produce 900 tons of clean coal per day, and the Company estimates that a productivity of 5.5 tons per man-day will be obtained.

At the present time the preparation of coal at the existing collieries is confined to screening and hand-cleaning. Lump, slack, and three sizes of domestic coals are made. In conjunction with the development of the McBean colliery, the Company is building a central washery to handle the whole of its output. This preparation plant will produce all sizes of washed coal required for industrial and domestic use. The Commission notes that the domestic sizes will be oil-treated to prepare a dustless fuel as the need for this kind of preparation of Nova Scotia coals for the domestic market is of long standing.

Intercolonial Coal Company Limited

The Intercolonial Coal Company operates three slope mines in the western portion of the Pictou field in the Westville area. Two of these mines work the lower bench of the Westville main seam. The top 9 feet of this 16-foot seam were extracted many years ago. The remaining 6 to 7 feet of the seam are being mined by room-and-pillar methods, but due to the irregular conditions special methods have had to be devised to meet local situations. Mining is by hand-pick and drilling is done with jackhammers or by hand. Loading is by hand directly into mine cars of about one ton capacity. Haulage is mainly by rope

but horses are used on subsidiary roads. Operations in the Company's other mine, which is on the underlying Scott Pit seam, are based on longwall advancing methods. Radialax cutters and air-drills are used for development work, and air-driven longwall cutters with 5-foot bars are used at the longwall faces, the lengths of which vary from 155 to 235 feet. In some sections the seam pitches sufficiently to permit the coal to slide on flat sheets, otherwise shaking conveyers are used.

The Company currently employs some 450 men. Production per man-day in 1939 and 1944 was as follows:

—	Mining Labour	Underground Datal	Total
1939	4.8	4.4	1.8
1944	5.8	4.1	1.7

Greenwood Coal Company Limited

The Greenwood Coal Company operates one slope mine in the Thorburn area of the field. The mine operates on the Captain seam, which averages 3 feet in thickness in the present workings. The slope extends some 1,400 feet and the Company has now almost completed the recovery of the reserves available under the existing lease from the Acadia Coal Company. Room-and-pillar mining is practised. Electric cutters are used and loading is done by hand directly into mine cars of about one ton capacity. Haulage is by rope from electrically-operated engines. In 1944 the Company employed about 80 men underground and about 25 on the surface. Man-day production covering all employees in 1944 was about one ton.

It is highly desirable that the Acadia Coal Company should effect an equitable agreement with the Greenwood Coal Company to provide the latter Company access to reserves adjacent to its present operations. The Provincial Government should lend any assistance necessary. As many of the independent companies hold subleases from the Dosco companies, the Provincial Government should review periodically the leasehold situation to ensure the welfare of the small operators.

Cumberland Coal Fields

The output from the Cumberland coal fields is almost entirely produced by four companies, one of which, the Cumberland Railway and Coal Company, a wholly owned subsidiary of the Dominion Coal Company Limited, accounted for 67 per cent of the total 1944 production of 880,799 tons. The output of these four companies in 1944 was:

	Tons
Cumberland Railway and Coal Company	595,443
Joggins Coal Company Limited	120,495
Hillcrest Mining Company Limited	92,490
Standard Coal Company Limited	71,095

Mining in Cumberland County is carried on in the Springhill and in the Joggins areas. The three smaller companies operate in the Joggins area, whereas the Cumberland Railway and Coal Company mines are located in the Springhill area.

Cumberland Railway and Coal Company

The Cumberland Railway and Coal Company operates three mines. One of these is a slope mine with its entry driven in the seam. A second mine operates from cross-measure drifts driven from this slope. The third enters the seams it works from a cross-measure tunnel driven from the surface. The three mines deliver their coal to a common bankhead. These mines are currently working four seams: No. 1 seam, a 10-foot seam which is split into two leaves of

approximately 4 feet each in the locality of the present workings; No. 2, a 9-foot seam; No. 6, a 6-foot seam; and No. 7, a 4.5-foot seam. The coal is classified as a high volatile "A" bituminous coal. Its ash content averages 9.7 per cent and its sulphur content 1.6 per cent. The calorific value averages 13,225 B.t.u./lb. It has a medium fusion point of ash and is a coking coal.

In the vicinity of the operations the seams dip to the west at about 32 degrees at the outcrops but gradually flatten at depth. At 11,400 feet from the mine entry, the dip of No. 2 seam has flattened to some 12½ degrees, at which point the vertical cover is some 3,821 feet. The workings are not unduly hot at that depth, the temperature being about 67 degrees. The strata consists of strong shales and sandstones and these strong formations permit the total extraction of No. 2 seam even at depth without undue maintenance of roadways. At depth, however, these strong strata are the cause of other serious operational problems. Stresses thrown on them by the removal of the coal are not immediately released but are built up until they reach such magnitude that, in the room-and-pillar system, the pillars disintegrate instantaneously and what is generally known as a "bump" occurs. In some cases where pillars had been drawn over a fairly extensive area without the breaking of the strong roof and where the neighbouring pillars were large and strong enough to withstand the stresses thrown on them, the roof itself broke along the pillar line and caused extensive damage in the neighbouring sections by the reaction which accompanied the relief of the stresses in the roof. For this reason the system of work in No. 2 colliery was changed over twenty years ago from room-and-pillar to longwall retreating. Since that time bumps have occurred but, generally speaking, they have not been accompanied by the widespread damage resulting from bumps in the room-and-pillar system, mainly because the long line of total extraction made possible by the longwall faces permit the roof strata to break off before the accumulated stresses in them become excessive. Moreover, the necessary development work required for longwall retreating has made it possible for boreholes to be drilled into the roof and floor of the seam to determine the character of the strata in the vicinity. Where a strong sandstone band of a thickness of 25 feet occurs in the roof and where the floor is strong, the seam is not worked. This has compelled the abandonment of a number of areas.

In the longwall retreating operations of No. 2 colliery, levels are driven at intervals of 400 feet to the colliery boundary and are connected for ventilation purposes every 500 feet. When the boundary is reached, three walls, having a total length of 1,200 feet, are worked until they reach the slope pillar or until ground where bumps may be expected to occur is encountered. Normally, neither undercutting nor shooting is required, but hand-picks are used to break down the coal adjacent to the roof and the floor. It is loaded by hand on reciprocating conveyers and delivered either to mine cars on the level at the bottom of the wall or on to a flight conveyer which transports it along the level and into mine cars at the loading point. No. 1 colliery, which works No. 1 seam from the slope of No. 2 mine, is operated on a similar basis, the coal in this instance being undercut by a longwall coal cutter and bored by jackhammers. Reciprocating conveyers are used at the face. In sections now being developed, it is planned to use the longwall advancing system. No. 4 colliery, which works No. 7 seam, operates on the longwall advancing system, using similar equipment to that used in No. 1 mine. A new mine is being developed through short cross-measure drifts from No. 4 mine. The Company is preparing to work a room-and-pillar system with duckbill loaders. The seams, particularly No. 7 seam, are gassy. Ventilation is supplied by electrically-operated fans located at the surface. In No. 2 colliery a booster fan is used. Arising out of the heavy gradients, haulage is by rope. Electricity is not used in the vicinity of the face, motive power in these areas being compressed air. All main pumps, fans and auxiliary hoists are electrically operated. The surface hoists and air compressors are steam driven.

In 1944 the Company employed 1,360 men. The productivity figures for 1939 and 1944 are as follows:

—	Mining Labour	Underground Datal	Total
1939	5.1	4.4	2.0
1944	5.7	2.6	1.5

The coal produced by the three collieries is prepared in a common preparation plant. The plus 4-inch coal is hand-picked while the 1-inch by 4-inch is washed through a Vissac jig. The minus 1-inch coal is separated into ¼-inch by 1-inch and minus ¼-inch. The fine slack is used in pulverized fuel boilers in the Maritime Provinces. After washing, the coal is screened into egg and nut sizes. Any size of coal coming from the preparation plant may be loaded separately or may be mixed for loading as required.

Joggins Area

The mines of the three principal operating companies in this area work two of the five seams, the Forty Brine and Kimberley seams, the average thicknesses of which in the areas mined range from 28 to 36 inches. To the east and at depth, the seams thin progressively and deteriorate in quality. The field is cut by numerous cross-faults of sufficient displacement to hamper mining operations, in some instances having permitted the infiltration of water and forced the abandonment of mines. The mines in the area are all slope mines and both room-and-pillar and longwall methods are used. Where cutting-machines and other mechanized mining equipment are used, they are electrically driven. The coal is classified as high volatile "A" bituminous but is of low grade, due to high ash and sulphur content. Calorific values average about 10,900 B.t.u./lb. Coal preparation is limited to screening.

The three principal companies employ nearly 500 men. Considering operating conditions, the mines have achieved commendable productivity, average per man-day production in 1944 being about 2 tons. One of the companies, the Joggins Coal Company, averaged 2.5 tons per man-day.

NEW BRUNSWICK

Production in New Brunswick is concentrated in the Minto coal field. A few small mines operate intermittently in the Beersville area but in aggregate they do not produce 400 tons a year. The Minto coal field is divided into many leaseholds and includes a large number of small mines. Production in 1944 was 345,123 tons as compared with 364,714 in 1937 and a peak production in 1941 of 523,344. In 1944 seven operators produced over 96 per cent of the total production. A recent arrangement between the Minto Coal Company and the Miramichi Lumber Company Limited has in effect reduced this number to six. These operators form The New Brunswick Coal Producers' Association. Operations in the Minto field include both stripping and underground mining, the former accounting for approximately 38 per cent of the total output.

Normally only one seam is mined and this seam ranges in thickness from 16 inches to 30 inches, averaging about 18 inches. In some areas, however, a thin lower seam 2 to 6 inches in thickness is mined in conjunction with the main seam. The main seam is flat-lying and is fairly uniform in thickness and quality over large areas, the only variable features of any importance being the presence of one or more partings and an occasional fault of small displacement. The coal is of high volatile "A" bituminous rank. It is of low grade, the ash content

averaging about 19 per cent and the sulphur content about 7.5 per cent. The coal is highly fractured and breaks down readily, run-of-mine coal normally containing about 66 per cent of 1½-inch slack. Calorific values range from 9,570 to 12,520 and average 11,610 B.t.u./lb. In about two-thirds of the area, the coal lies within 50 to 170 feet of the surface. In the remaining third, it occurs within 20 to 50 feet of the surface. It is usually underlain with 2 to 5 feet of grey shale. The roof is generally weak, but in some instances consists of massive sandstone. Mine gases are not of any great operational importance. Owing to the low altitude of the area, considerable difficulties are incurred in respect to water, notably in areas to the dip of the seam. The mines pump from 30 to 72 tons of water per ton of coal hoisted.

Underground mining is normally carried on by room-and-pillar methods. Entry to the mines is usually by shafts, the location of the entries being determined by the local drainage situation. The single entry system is common but double entries are used in a few mines. These entries are driven as narrow as possible due to the difficulty of roof support. Apart from the Minto Coal Company, which uses an electrically-driven coal cutter in its longwall operations and hand-loading to shaker conveyers, none of the mines are mechanized. Drilling is done by hand. Mine cars are small and are hand-pushed to and from the shaft.

Existing stripping operations have been confined largely to areas where the overburden is predominantly glacial till rather than rock. Typical units are small, both in respect to areas under operation and machinery used. Normally the latter consists of a steam-driven drag line with a 90 to 100-foot boom and a 3-cubic yard bucket. Practically all of these drag lines date prior to 1932. Surface water presents serious difficulties. Most pits contain an abundance of water which interferes with the loading of coal and to a much larger extent with its transportation from the pits, which become quagmires in rainy weather. Some of the roads from the pits to the railroads are almost impassable during rainy weather, and the wet coal is largely unmarketable in winter months due to freezing. The ratio of cubic yards of overburden to one ton of coal recovered is 15·8.

The following table gives the output and tons per man-day production of the principal companies for 1944.

Name of Company	Production Tons	Tons per Man-Day
Minto Coal Company	122,588	1.4
Avon Coal Company Limited	47,466	1.7
Miramichi Lumber Company	40,386	1.3
Rothwell Coal Company	39,693	1.2
King Coal Mines	22,270	1.2

An average production of 1·14 tons per man in underground mining in 1944 is raised to 1.45 when stripping operations are included.

The nature of the coal deposits and the physical difficulties are such that mining in New Brunswick will remain very largely a local industry. The stripping operations could be improved by the use of more modern equipment but no material improvement in underground operations can be anticipated. In general it would appear that the coal resources of the Minto coal field are too limited to permit the current multiplicity of leaseholds and operations to continue with any reasonable expectation of efficient operations. Some consolidation might contribute to the introduction of larger scale stripping operations, the underground recovery of coal from the most accessible points, and a reduction of mining costs generally by systematic drainage of the district. It has been

suggested that the field might benefit by a central washing plant located at the New Brunswick electric power station at Grand Lake. It is doubtful whether such a proposal is practical or economically sound. This is a question which must be resolved by the operators.

SASKATCHEWAN

The total output of Saskatchewan mines in 1944 was 1,372,766 tons as compared with 1,049,348 tons in 1937 and 579,424 tons in 1930. Some small scale mining has been carried on intermittently in the Upper Cretaceous deposits occurring in western Saskatchewan but production is concentrated in the Tertiary deposits in the south and, in particular, in the Estevan area of the Souris River Valley district in the south-east. These Tertiary lignite deposits extend from the Manitoba—Saskatchewan border almost to the Alberta boundary, and some small mines produce for local consumption in the westerly Cypress Hills and Wood Mountain—Willowbunch districts. Some 30 mines operate in the Estevan area, 13 of which are shipping mines. These shipping mines account for approximately 97 per cent of the total output of the Saskatchewan mines, of which there are about 85. In 1944, four companies accounted for over 90 per cent of the total output and two of these produced about 80 per cent of the total. The output of these companies and their per man-day production in 1944 were:

—	Production	Man-Day Production
	tons	tons
Western Dominion Coal Mines Limited	706,536	12.3
Manitoba and Saskatchewan Coal Co. Ltd	401,853	9.1
Eastern Collieries	91,887	14.0
Roche Percée Coal Mining Company Limited	50,843	13.0

The increase in production in Saskatchewan since 1930 is largely the result of the introduction of large scale stripping operations in the Estevan area. Approximately 85 per cent of the output of the four larger companies comes from stripping operations, the underground production coming from the Manitoba and Saskatchewan Coal Company, which secures nearly 60 per cent of its output from deep seam mining.

The coal is recovered from four of the eight seams in the area. These are numbered in descending order and have average thicknesses of 5, 5, 7 and 10 feet. They occur generally within 200 feet of the surface and are flat-lying. The seams mined are separated by intervals averaging 52, 20 and 25 feet. Stripping operations are concentrated on the Estevan or No. 3 seam which has a relatively shallow overburden north of the Souris River Valley. The coal classifies as lignite. Moisture content averages 35 per cent, ash 6.1 to 9.3 per cent, sulphur 0.4 per cent. Calorific values range between 6,905 and 7,420 B.t.u./lb.

The large open-cut mine operated by the Western Dominion Coal Company is equipped with a 10-yard 320-B Bucyrus-Erie power shovel and a 5-yard 5-W Bucyrus Monighan walking dragline. These draglines strip the overburden which averages between 15 and 24 feet but at certain points reaches a maximum of 50 feet. The exposed coal is then cleaned with bulldozers and shot lightly with black powder. Two power-loading shovels of 2.5 and 3.5-cubic yard capacity load the coal into 20-ton Euclid trucks, of which the Company has seven, for transportation to the tipple where the coal is screened and, where necessary, crushed. The smaller companies, two of which contract part of their operations, use diesel tractors, bulldozers and scraper equipment to remove the overburden,

and the shovels and trucks are smaller, corresponding with the size of their operations. Preparation includes crushing and screening. The transportation arrangements as well as stripping and loading operations of these companies are generally efficient.

The underground operation of the Manitoba and Saskatchewan Coal Company is a shaft mine, the shaft being 65 feet in depth. Room-and-pillar mining is used. Rooms 25 feet wide on 35-foot centres are turned at 45 degrees from the panel entries. The pillars are not drawn. In the locality of the mine the coal seam ranges in thickness from 9 to 14 feet. Seven feet only of the seam are recovered as some of the coal is left as floor and some as roof to reduce timbering cost. As there is no gas, little water, and a uniform seam with a working height of about 7 feet, mining conditions are excellent. Operations at the face are generally mechanized on the basis of electricity although there is some hand-loading. Trolley locomotives, one 10-ton, two 8-ton and one 5-ton, are used on the main haulageways but only one loading machine is served by a gathering locomotive; gathering is generally accomplished by the use of horses. Track is 42-inch gauge with 40 to 56-pound rails and the wooden mine cars used are about 2.5-ton capacity. The coal is screened over a modern 5-track tipple into box cars and hauled on the company railroad to the C.P.R. or C.N.R. tracks at Bienfait.

From a technical point of view, the efficiency of this underground operation could be increased by the installation of larger mine cars, the use of locomotives for gathering from the loading machines, and the replacement of the shallow vertical shaft by a slope equipped with belt conveyer. The Company is aware of the desirability of improvements along these lines but is faced with the difficult task of assessing the return which would be received from capital so invested in view of the intense competition from the strip mines. Underground operations in the Estevan area are more affected by the seasonal nature of the Saskatchewan coal mining industry than are the strip mines.

ALBERTA

Production in Alberta in 1944 amounted to 7,428,708 tons, of which 4,765,884 tons were bituminous coal and 2,662,824 tons were sub-bituminous. The bituminous tonnage includes a small quantity of semi-anthracite from the Cascade area near Banff, and the sub-bituminous output includes a small amount of lignite from the Pakowki area in the southeastern part of the Province. In 1944 there were 196 operators, most of whom were producing for purely local consumption. The following tabulation groups the operators according to their annual output. The figures also indicate a decrease in the number of operators since 1930, a trend which has accompanied an increase in the annual output of the Province.

Year	Production tons	Number of Operators					
		Total	Under 1,000 tons	1,000 to 10,000 tons	10,000 to 100,000 tons	100,000 to 200,000 tons	Over 200,000 tons
1930	5,755,528	290	165	63	43	11	8
1935	5,462,894	313	166	81	51	9	6
1940	6,203,839	283	134	86	44	9	10
1944	7,428,708	196	69	70	35	7	15

Source: Dominion Bureau of Statistics.

It will be recalled from previous discussion of Alberta coal reserves that the deposits occur in fifty areas and that these may be grouped in four regions, Inner and Outer Foothills belts adjacent to and in the Rocky Mountains and two

Plains regions on the eastern side of the Alberta Syncline. The location of these fifty areas and their grouping is apparent on Maps 8 and 9 appearing in the chapter on Coal Reserves. Mining operations are confined to thirty-two of these fifty areas. The following table gives the output of coal in Alberta by area and rank in 1939 and 1944.

OUTPUT OF COAL AND NUMBER OF MINES BY AREA AND RANK

—	1939	1944	Percentage of Total Output 1944	Percentage of Bituminous or Sub-bituminous 1944	Number of Operators 1944
	(Tons)	(Tons)			
Bituminous—					
Cascade	194,451†	363,314	4.9	7.6	2
Nordegg	151,107	351,869	4.7	7.4	1
Crowsnest	1,400,802	1,943,277	26.1	40.8	7
Mountain Park	810,584	892,954	12.0	18.7	4
Coalspur	360,436	651,340	8.8	13.7	6
Lethbridge	329,416	481,844	6.5	10.1	7
Saunders	40,736	63,926	0.9	1.3	2
Pincher	1,374	660	–	–	1
Pekisko	5,385	5,864	0.1	0.1	2
Prairie Creek	104,063	7,637	0.1	0.2	1
Magrath	431	–	–	–	–
Morley	107	2,581	–	0.1	1
Halcourt	2,992	618	–	–	4
Total	3,401,884	4,765,884	64.1	100.0	38
Sub-bituminous—					
Drumheller	1,223,337	1,678,322	22.6	63.0	23
Edmonton	472,132	389,333	5.2	14.6	26
Tofield	47,667	101,895	1.4	3.8	4
Brooks	10,980	88,365	1.2	3.3	2
Taber	12,781	74,936	1.0	2.8	6
Pembina	38,955	72,251	1.0	2.7	5
Camrose	54,693	65,303	0.9	2.5	7
Sheerness	36,784	49,780	0.7	1.9	8
Carbon	80,032	46,896	0.6	1.8	14
Castor	38,110	40,896	0.6	1.5	28
Gleichen	26,091	16,430	0.2	0.6	6
Redcliff	26,104	10,603	0.1	0.4	2
Champion	15,273	7,177	0.1	0.3	3
Ardley	15,694	7,109	0.1	0.3	10
Big Valley	2,447	5,471	0.1	0.2	4
Rochester‡	5,069	4,257	0.1	0.2	2
Milk River	5,961	1,624	–	0.1	2
Wetaskiwin	3,224	1,085	–	–	1
High Prairie	–	588	–	–	1
Whitecourt	229	287	–	–	3
Pakowki	1,464	216	–	–	2
Pakan	202	–	–	–	–
Sexsmith	95	–	–	–	–
Total	2,117,324	2,662,824	35.9	100.0	159
Alberta Total	5,519,208	7,428,708	100.0		197§

Source: Dominion Bureau of Statistics.
† Includes 10 tons mined in Highwood District.
‡ Westlock included with Rochester area.
§ Total should read 196 but one company operates in two areas.

Production of low, medium and high volatile "A" bituminous coal is concentrated in four areas in the Inner Foothills belt, namely, the Crowsnest, Cascade, Nordegg and Mountain Park areas. The mines in these areas account for nearly 48 per cent of the total Alberta output and nearly 75 per cent of the total bituminous production in the Province.

High volatile "B" and "C" bituminous coal is mined in the Outer Foothills belt and in the Lethbridge and Halcourt areas in the Plains. Production in the Foothills is largely confined to the Coalspur and Saunders areas. A very small tonnage is produced in the Halcourt area but the Lethbridge mines account for approximately 39 per cent of the total high volatile "B" and "C" bituminous production.

The sub-bituminous coal is mined in the Plains, 10 of the areas accounting for 98 per cent of the total sub-bituminous output. Two areas, Drumheller and Edmonton, produced nearly 78 per cent of this output.

A different grouping of the industry is suggested in a consideration of the markets served by the mines. The high rank bituminous coals mined in the Inner Foothills belt are largely sold for railway and industrial use, the mining companies being commonly referred to as the "steam" coal operators. The output of high volatile "B" and "C" bituminous coal from the Coalspur and Saunders areas in the Outer Foothills belt mainly reaches the domestic market, a substantial tonnage however going to the railways. Production in the Lethbridge and other Plains areas is chiefly for domestic purposes. This grouping has some considerable merits for our purposes as the problems of the "steam" and "domestic" mines are in some instances distinct. For example, a price premium exists on lump-sized coal for domestic use and the "domestic" operators must necessarily select in these circumstances mining methods calculated to produce a high proportion of lump coal. Again, the "domestic" mines are more seriously affected by the seasonal fluctuations of the coal market. As some 1,300,000 tons are approximately 17 per cent of the total Alberta output is secured from strip-mines, it is also possible to divide the industry between stripping and underground operations. The different physical conditions encountered by the mines in various areas is also an important factor in grouping the industry. Broadly speaking, the mines in the Foothills belts work seams which have been folded and faulted by mountain building forces and the coal is often crushed and very friable. The pitching seams of the Foothills belts contrast with the flat-lying seams of the Plains regions. Roof pressures in the Plains are normally very much less severe than in the Foothills belts and the mines are less gassy.

In the discussion which follows, the Alberta coal mining industry has been grouped by taking a balance of these various factors and the division is as follows:

1. The principal mines operating in the Inner Foothills belt where the seams are pitching and the market served is industrial and railway.
2. The principal mines in the Coalspur and Saunders areas of the Outer Foothills belt where physical conditions are similar to those in the Inner Foothills belt, and where the market is industrial, railway, and domestic.
3. The principal mines in the Drumheller, Lethbridge and Edmonton areas, the most important producing areas on the Plains, where the seams are flat-lying and the market is domestic.
4. Stripping operations.

Inner Foothills Belt

Thirteen companies operate in four areas of this belt, nine of which account for nearly 99 per cent of the total output. These companies, together with the Crow's Nest Pass Coal Company which operates mines in the adjacent British

Columbia coal fields, form the Western Canada Bituminous Coal Operators' Association. The areas in which mines operated by the Alberta companies are located, their annual production, average number of workers employed and output per man-day in 1939 and 1944 appear below:

—	1939			1944		
	Output	Output per Man-Day	Average No. of Employees	Output	Output per Man-Day	Average No. of Employees
Crowsnest—						
West Canadian Collieries Ltd....	522,049	4.58	614	972,865	3.69	941
International Coal and Coke Co. Ltd..........................	353,552	3.85	438	425,792	3.53	516
Hillcrest Mohawk Collieries Ltd.	....	....	....	293,299	3.64	315
McGillivray Creek Coal and Coke Co. Ltd......................	297,524	3.41	376	249,813	2.82	338
Cascade—						
Canmore Mines Ltd.............	192,957	3.15	273	361,318	4.32	311
Nordegg—						
Brazeau Collieries Ltd...........	151,107	3.55	218	351,869	3.50	439
Mountain Park—						
Cadomin Coal Co. Ltd..........	295,424	3.39	300*	327,017	2.68	285
Luscar Collieries Ltd.............	164,386	3.32	168	274,295	3.55	277
Mountain Park Collieries Ltd....	313,500	3.70*	324	248,811	3.30	277

*Estimated

The mining conditions under which these companies operate vary considerably. Characteristically the seams are thick and vary greatly within short distances. Due to mountain-building forces and earth movements, the seams are folded and serious faults occur. The dip of the coal beds ranges from 10 degrees to 60 degrees, in some instances levelling off at depth of about 2,000 feet to some 6 degrees. In some instances, notably in the Mountain Park area, the seams are completely overturned. The coal which, as previously noted, ranges in rank from low volatile to high volatile "A" bituminous has a medium to high ash content and is low in sulphur. Average calorific values range from 12,490 to 13,910 B.t.u./lb. and the fusion point of ash is high. Roof and floor conditions fluctuate, roof control in some areas requiring constant attention due to severe pressure at depth. Generally the mines are gassy, and in some instances water difficulties occur.

Entry to the mines is normally by slope or drift. A number of the companies, including West Canadian Collieries Limited in its Bellevue mine, International Coal and Coke Company Limited, Cadomin Coal Company Limited and Luscar Collieries Limited, have secured access to the seams by means of rock tunnels driven across the measures. This practice has been found successful in reducing the expense of maintaining roadways.

These companies carry on both underground and open-cut mining. West Canadian Collieries in the Crowsnest area is presently prospecting an open-cut operation. One of the four mines operated by the Cadomin Coal Company in the Mountain Park area is a strip-mine and accounts for approximately 70 per cent of the Company's output. Luscar Collieries in the Mountain Park area also strips some coal at its No. 3 mine. In another area where the seam is nearly vertical and varies in thickness from 40 to over 100 feet, the surface has been stripped and deep holes drilled to reach the counter level in No. 2 mine. The coal

is shot and drawn into chutes from whence it is loaded into mine cars and hauled out through No. 2 mine drift mouth. This operation is locally referred to as the "glory hole".

The method of mining underground is usually room-and-pillar but in some instances a small proportion of the coal is recovered by a modified longwall system. Where coal cutting is required, compressed-air picks are typical but in many instances cutting is not required. Chain-cutters are used in a few instances in entry driving and in the modified longwall operations. Some radialax machines have been used, largely for experimental purposes. Where the pitch of the seams is favourable (over 20 degrees), it is the general practice to drive rooms up the pitch and work the coal to the haulage entry over sheet iron slides. Where the gradient is unfavourable, conveyers and in some instances horses and hand-pushing are employed. Haulage is usually direct or main-and-tail rope haulage, compressed-air locomotives being used by some of the companies underground where gradients permit and for haulage from the top of the mine slope to the tipple. West Canadian Collieries, for example, has 15 of these locomotives in operation. Electricity is not used underground but there has been a steady increase in its use at the surface over the last five years.

The mines all have facilities for coal washing and screening, a number of the companies dust-proofing with calcium chloride coal sold for domestic purposes. International Coal and Coke Company operates 104 Beehive coke ovens in the manufacture of metallurgical coke. In 1944, the Company produced 68,000 tons of coke. In the Cascade and Nordegg areas where the low volatile coals are particularly friable, excessive volumes of fines are secured from mining operations. To secure a market for these, a considerable proportion of the output is briquetted. An asphalt binder is used and the briquettes command a premium as a railway locomotive fuel and for domestic purposes.

In recent years considerable experimental work using various types of air-driven track loaders, pit car loaders, conveyers and scrapers has been carried out by these companies in order to overcome shortages of manpower and to improve their competitive position in the market. The results in many instances have not been entirely satisfactory and modifications are being studied. The most favourable progress has been made in entry driving where air-driven track loaders have proved satisfactory in driving rock tunnels and loading coal in the entries. The operators are keenly aware of the necessity of improving their competitive position by adopting the most modern machinery and techniques where these can be applied to the peculiar physical conditions in which they operate. Fluctuations in market conditions have been responsible for some of the delay in securing the improved productivity implicit in increased mechanization. Whereas in 1944 the "steam" mines operated at an average of 265 days, in 1939 they averaged 186 days and in 1934, 143 days. It has not been apparent to the operators that in these circumstances there would be an adequate return of capital so invested. The improved market conditions of the war period and their recent experimental work with machinery have placed the companies in a better position to measure the merits of more extensive mechanization.

Outer Foothills Belt

Production in this belt is very largely concentrated in the Coalspur and Saunders areas. Two of the companies operating in the Coalspur area, Sterling Collieries Limited and Coal Valley Mining Company Limited, operate strip

mines. The annual production, employment and output per man-day of the four principal companies in the Coalspur area and the two companies in the Saunders area for 1939 and 1944 appear below:

—	1939			1944		
	Output	Output per Man-Day	Average No. of Employees	Output	Output per Man-Day	Average No. of Employees
Coalspur—						
McLeod River Hard Coal Co. Ltd	37,478	3.62	78	217,472	3.37	259
Sterling Collieries Ltd	118,335	5.07	78	143,180	5.50	82
Coal Valley Mining Co. Ltd	128,124	5.58	62	137,240	5.26	79
Foothills Collieries Ltd	45,331	2.80	76	117,204	3.83	117
Saunders—						
Bighorn and Saunders Creek Collieries Ltd	22,318	2.42	62	39,407	2.16	70
Alexo Coal Co. Ltd	18,307	2.33	52	24,519	1.80	47

The coal deposits in these Outer Foothills areas are geologically younger than those of the Inner Foothills belt, being mainly of Upper Cretaceous age. The mountain pressures which matured these younger coals to bituminous rank also disturbed the coal seams so that physical conditions are similar to those in the Inner Foothills belt. There are three principal seams in these areas separated by stratigraphic intervals of about 200 feet. The Upper Val d'Or seam is generally in two leaves separated by a heavy parting, the upper part being about six feet while the lower part is about ten feet. The underlying Silkstone seam is in some areas as much as 14 feet thick. The lowest or Mynheer seam, where mined underground, ranges between 12 and 16 feet in thickness. In areas where the seam is being stripped, the total thickness of coal ranges from 50 to 200 feet, much of which is recoverable within a limit of 250 to 300 feet of overburden. In the Coalspur area where the strip mines are operating, earth movements have led to an even greater concentration of coal. There is a wide range in the quality of the coals mined in these areas. Most of them are hard and will withstand handling and exposure to weather. However, where the seams have been subject to severe faulting, they are friable. Their ash content is somewhat lower than the coals of the Inner Foothills belt and the sulphur content is negligible. Calorific values range from 10,360 to 11,400 B.t.u./lb. The fusion temperature of ash is medium.

The method of mining underground is room-and-pillar, rooms being usually turned up the pitch. Rooms are turned on the advance and, in most instances, the pillars are not drawn. Cuttings are commonly left in the mines owing to the difficulty of securing a market for fine sizes. Mechanization is not extensive although there has been some improvement during the war period, notably in the case of the McLeod River Hard Coal Company which was acquired by Canadian Collieries (Dunsmuir) Limited in 1941. In the smaller mines the haulage on the levels is by horse, and slope haulage is by rope. The McLeod River Hard Coal Company now employs a battery locomotive in one of the mine levels and has acquired an air-driven track loader for entry driving. Entries are also advanced by hand-shovelling onto shaker conveyers. Coal is not extensively prepared in these areas and preparation is largely limited to screening. From a technical point of view, the productivity of these mines could be improved by increased mechanization, and it is apparent from their recent initiative that the operators realize the necessity of securing this improvement in order to

retain their markets. The seasonal nature of the domestic market which these mines serve and the difficulties of marketing the fine sizes at an adequate price are factors which have delayed investment in the necessary mining equipment.

The two strip mines are operated on the Mynheer seam. The extreme thickness of the coal seam in the areas under operation has been noted; in view of this thickness the stripping operations reach a considerable depth. The average ratio of overburden to coal over a period has ranged from 1.0 to 1.5. Coal Valley Mining Company has several pits in operation or in the prospective stage and drilling has proved the deposit for several miles giving the Company thirty to forty years of future operations on the basis of proved coal. In view of this, the Company has proceeded with the erection of a new cleaning plant with a capacity of 165 tons per hour and a power plant. Sterling Collieries has an inadequate cleaning plant but the life of the present pit has been estimated to be only three or four years.

Plains Regions

The most important mining areas in the Plains are the Lethbridge, Drumheller and Edmonton areas.

Lethbridge

Seven companies operate in this area, all of which, with the exception of Lethbridge Collieries Limited, are small scale mines. Several of these are strip mines. Some particulars of the production records of Lethbridge Collieries, which accounts for about 90 per cent of the area output, appear below:

—	1939			1944		
	Output	Output per Man-Day	Average No. of Employees	Output	Output per Man-Day	Average No. of Employees
Lethbridge Collieries Ltd..........	234,768	3.27	366	431,425	3.46	553

The coal beds in the Lethbridge area are flat-lying with a slight dip toward the northwest. Only one of the several seams in the area is worked extensively. This seam varies in thickness from 3 to 9 feet but averages 4.5 and 5.5 feet in the mines operated by Lethbridge Collieries Limited. Typically the ash content of the coal is about 10 per cent and sulphur 0.6 per cent. Calorific value averages 10,900 B.t.u./lb. The fusion point of ash is medium. The coal is accessible by drifts along the streams but entry in this Company's mines is by shaft, one being some 260 feet and the other 360 feet. The roof is generally poor and usually gassy, but some gas occurs in the faults.

The standard method of mining is room-and-pillar and, in general, the pillars are not drawn. Drilling is done by hand-held electric drills. The coal is hand-cut and sheared by electrically-driven coal-cutters and the coal hand-loaded. Haulage is by horse and endless rope. In some instances, the men push the empty cars. The Company has two duckbill loaders in operation in one mine but has discontinued their use in the other mine due to difficulties of varying roof conditions. The Company operates a spiral separator. The productivity of these mines, notably the Shaughnessy mine, could be improved by increased mechanization.

Drumheller

In 1944, 23 companies operated mines in the Drumheller field. Ten of these companies, all members of the Drumheller Coal Operators' Association, account for approximately 90 per cent of the area output. Some particulars of their output in 1939 and 1944 are as follows:

—	1939			1944		
	Output	Output per Man-Day	Average No. of Employees	Output	Output per Man-Day	Average No. of Employees
Rosedale Collieries Ltd	160,454	3.02	336	232,348	2.81	322
Midland Coal Mining Co. Ltd	107,191	3.97	141	224,298	4.01	220
Regal Coal Co. Ltd	140,843	6.0	132	221,590	4.3	205
Red Deer Valley Coal Co. Ltd	70,903	3.8	111	188,098	3.50	238
Murray Collieries Ltd	76,696	4.94	103	142,652	4.25	158
The Monarch Coal Mining Co. Ltd	89,970	4.43	83	128,392	3.92	130
Newcastle Collieries Ltd	69,530	3.73	110	110,135	3.52	149
Brilliant Coal Co. Ltd	68,020	4.71	79	93,036	4.43	94
Hy-Grade Coal Mining Co. Ltd	90,085	3.94	108	92,952	2.95	131
Western Gem and Jewel Collieries Ltd	96,910	3.70	220	69,971	2.55	130

The mines in this area are located on both sides of the Red Deer Valley and three seams are worked. Seam No. 1, the lowest workable seam, has an average thickness of 5.5 feet. Seam No. 2 which lies from 35 to 50 feet above ranges from 3.5 to 5.5 feet. Seam No. 5 averages 3.5 feet in thickness and the interval separating it from No. 1 seam varies in different parts of the field reaching a maximum of 105 feet. The coal is hard and blocky and varies in quality in the three mining sections of the field, namely, the East Coulee, Rosedale and Wayne, and Drumheller districts. The ash content of the coal ranges from 5.8 per cent to 7.2 per cent. Sulphur is about 0.5 per cent. Calorific values range from 9,500 to 10,075 B.t.u./lb., and the fusion point of ash is low. The coal beds are flat-lying and the roof is shale and sandstone, both of which are lense-like. Whereas the roof is good when dry, the sandstone tends to swell and scale. The mines are not gaseous.

Entry to the coal is by slope, shaft and drift. The room-and-pillar system of mining is used generally, with some modifications to meet local conditions. One small mine operates on the longwall system. The mining methods are directed to securing a maximum output of larger sizes of coal owing to the premium which these sizes command in a domestic market. For this reason pillars are frequently not drawn and the cuttings left in the mine. The coal is sheared as well as undercut by machines, and some of the mines use cardox in order to increase the percentage of lump coal. Face loading is generally by hand into mine cars or conveyers, duckbill loaders being used in a few instances at the face. Machines of this type have been installed in six mines but this equipment has been more extensively used for entry driving. Haulage in six of the mines is by rope. In eleven mines storage battery locomotives are employed and in six, trolley locomotives have been installed. Horses are used in most of the mines for gathering.

Recent experience with the use of duckbills and conveyers has shown that they can be used to advantage for driving entries during the summer months and in the room panels during the producing months. It is possible that a substantial improvement in productivity would be secured if mobile loaders were used. This can only be established after experimentation and possibly adaptation of the machinery to suit the conditions of the field. This experimentation is essential if the mines in this field are to maintain their competitive position. The introduction of increased mechanization and the trend in the demand for smaller sized coal for automatic stokers will undoubtedly require a provision for more

adequate preparation facilities. Several problems are facing the operators in determining the merits of this further capital investment. The domestic market is inherently seasonal. The operators informed the Commission that over the period 1930 to 1943 their mines worked an average of 158 days per annum. This figure includes days on which only a part of the normal complement of men were employed. Only 118 days were worked with a full complement of men. The coal reserve situation is somewhat uncertain and, until this is removed, an extensive program of mechanization will probably be limited to the few mines which, having recently come into operation, have a life expectancy of at least 25 years.

Edmonton

The Edmonton area is characterized by a large number of small operators, some 26 mines operating in the area in 1944. A number of these mines are strip mines. Five of the mines accounted for approximately 64 per cent of the production, their records being as follows:

—	1939			1944		
	Output	Output per Man-Day	Average No. of Employees	Output	Output per Man-Day	Average No. of Employees
Edmonton—						
The Great West Coal Co. Ltd....	69,760	3.3	94	83,169	2.9	103
Banner Coals Ltd................	35,182	4.0	49	55,168	3.5	70
Kent Coal Co. Ltd...............	47,487	3.6	67	44,827	3.1	61
Beverly Coal Co. Ltd............	53,710	4.2	59	41,147	2.8	48
Edmonton Collieries Ltd.........	6,012	2.9	13	26,597	4.3	27

Three of the four commercial seams in the Edmonton area are mined. These seams vary in thickness from 3 to 7 feet and are separated by intervals of approximately 30 and 120 feet. The seams are flat-lying and the mines are non-gaseous. The coal is of slightly lower rank than the Drumheller coal and classifies as sub-bituminous "C" as compared with the sub-bituminous "A" and "B" coals of the Drumheller area. The grade of the coal is fully comparable. Typically they have a calorific value of about 8,725 B.t.u./lb.

Room-and-pillar is the prevailing system of mining and generally the pillars are not recovered. In the Black Diamond mine of the Great West Coal Company Limited, however, the present method is to drive rooms 12 feet wide on 77-foot centres, thus developing blocks 65 feet square. The blocks or pillars are mined retreating. The longwall method is used in the Penn mine of Banner Coals Limited. Most of the coal is undercut with electric coal-cutters and hand-loaded into mine cars. Some experimental work has been done with shaking conveyers and duckbills. In the longwall operation one shaking conveyer is installed on a face 400 feet long. Haulage is by rope, horse and hand-pushing. Two storage battery locomotives have been installed in the Black Diamond mine. Preparation is limited to screening.

There is little doubt that the productivity of the mines in this area could be improved by further mechanization, with particular reference to loading machines and conveyers. These might be used in entries in the summer months and transferred to the working faces during the busy winter months. The operators have to weigh the advantages to be gained from this capital investment.

Stripping Operations

According to the Federal Department of Mines publication, Coal Mines in Canada, there were in Alberta in 1944 some 44 stripping operations or mines from which the principal production came from such operations. Two other companies supplement their underground production by stripping. Statistics of

the output of these mines in 1944 are not available but in 1945 they produced 1,301,591 tons or approximately 17 per cent of the total Alberta production. This tonnage included 473,771 tons of bituminous coal and 827,820 tons of sub-bituminous or 10.3 per cent of the total bituminous production and 25.8 per cent of the total sub-bituminous production.

Approximately 90 per cent of these mines are located in the Plains regions. However, a similar concentration is not apparent on the basis of output. Thus in 1945, 473,771 tons, all the bituminous coal so mined, was produced in the Foothills areas and 827,820 tons in the Plains regions. The strip-mines operating in the Foothills have been referred to in earlier pages. The strip-mines in the Plains are widely scattered and generally operate on a small scale and have only local significance. The 10 principal stripping operations in the Plains regions are located in the Tofield, Sheerness, Taber, Brooks, Camrose and Castor areas. In 1944 these included six mines operated under special arrangements with the Emergency Coal Production Board. The 1944 production of these mines, their output per man-day and the areas in which they are located are recorded below. The emergency mines are marked with an asterisk.

Stripping Mines	1944	
	Output	Output per Man-Day
Brooks—		
Birnwel Coal Ltd.*	86,060	13.48
Camrose—		
Camrose Collieries Ltd.*	27,989	2.85
Castor—		
Castor Creek Collieries Ltd.*	4,585	5.30
Sheerness—		
Sheerness Coal Co. Ltd	33,373	10.58
Taber—		
Continental Coal Corp. Ltd.*	29,984	11.99
Western Ventures Ltd.*	26,508	10.68
Majestic Mines Ltd.*	10,223	12.86
Tofield—		
Black Nugget Coal Co. Ltd	11,418	12.70
Dodds Coal Mine	33,367	9.07
Tofield Coal Co. Ltd	54,169	5.35

* Emergency Stripping Mines.

BRITISH COLUMBIA

Production in the Province of British Columbia in 1944 amounted to 2,134,231 tons. Of this, 1,221,621 tons came from the Crowsnest Pass area in the southeastern part of the Province, 774,477 tons from Vancouver Island and 138,133 tons from various Inland areas. Most of the output of the mines in the Inland areas is for local consumption. These mines are located in the north-eastern, central and south central coal fields reviewed in the chapter on Coal Reserves.

Crowsnest Area

The principal company operating in this area is the Crow's Nest Pass Coal Company Limited. The Company operates two mines, located at Elk River four miles east of Fernie and at Michel. In 1944 the output of these mines was 1,064,341 tons as compared with 629,392 in 1939. In the same years, the Company employed 1,094 and 636 employees respectively. The output per man-day in 1944 was 3.8 tons as compared with 4.3 in 1939.

Some eighteen coal seams, with an aggregate thickness of 170 feet, occur in the Fernie Basin area in which these mines operate. Along the Elk River Basin, the seams outcrop at elevations of 1,000 to 1,500 feet above the river and dip steeply eastward, the angle of dip gradually lessening as the beds reach the base of the syncline. Further eastward, the seams turn upwards and are exposed again on the opposite side of the mountain. Where mined, the seams range in inclination from 5 to 45 degrees. The mine at Michel is presently working two seams; seam B ranges in thickness from 5 to 5.5 inches; seam A averages about 12 feet in thickness and lies some 50 to 200 feet below seam B. The Elk River mine operates in three thick seams. Roof conditions vary considerably from a tender top of thin shales interbedded with streaks of coal to strong, heavy shales, sandstones and conglomerates. At depth, these conditions have contributed to the occurrence of "bumps" somewhat similar to those referred to in previous discussion of mining conditions in the Springhill coal field in Nova Scotia. The coal deposits are of medium volatile bituminous rank and constitute the most important reserve of coking coal in Canada. The ash content in the British Columbia Crowsnest is lower than in the Alberta Crowsnest fields and averages about 8.5 per cent. Sulphur content is negligible; the fusion point of the ash is high; and calorific values average about 13,930 B.t.u./lb.

In these mines, both room-and-pillar and modified longwall mining methods are employed. The Michel colliery has been developed by means of two cross measure rock tunnels each approximately 4,800 feet long and four level course entries driven off these rock tunnels into the various seams. Inclines are then driven to the outcrops to the rise at intervals of 1,600 feet. Pairs of rooms are then driven across the pitch on either side of the inclines at intervals of 300 feet for distances of 750 feet. Splits are then driven from room to room at intervals of 50 to 90 feet forming pillars 250 feet long and 50 to 90 feet wide. The pillars are then extracted by longwall or swivel work. All mining machines are driven by compressed-air. Duckbill places and longwalls are cut in some instances by chain type undercutters while in others the coal is cut by radialax machines. Compressed-air picks are provided in all working places. Whereas in some sections of the mine the coal is soft enough to be mined with air picks, most of the coal is shot with permissible powder. Shaking conveyers are used in the splits from the faces to the rooms where the pitch does not exceed 28 degrees. Above this pitch chutes are used. Conveyer belts are used in the rooms delivering to belts in the inclines where the pitch is suitable. The incline belts, or chutes where the pitch is excessive, deliver coal to mine cars in the entries from whence the cars are hauled to the surface by compressed-air locomotives. The method of work in the Elk River colliery is similar to that at the Michel colliery. Horse and rope haulage is more extensively used and at Mines Nos. 9 and 10, which are located at an elevation of more than 700 feet above the colliery plant, a rope and button retarding conveyer system 1,500 feet long is used to transport the coal from the mine portal down the mountain side to the preparation plant. About 20 per cent of the coal is loaded by machinery in the Company's mines and about 70 per cent is transported from faces to entries by shaker conveyers. At both collieries, large modern cleaning plants have been erected. At Michel, the company has two ten-oven batteries of Curran-Knowles by-product ovens with a capacity for coking 220 tons of coal per day. Some Beehive ovens are also in service.

Vancouver Island

Mining operations in Vancouver Island occur in two areas, Nanaimo and the more northerly Comox area. Apart from small salvage operations near Nanaimo, Canadian Collieries (Dunsmuir) Limited is the sole operator on the Island. The company in 1944 produced 760,222 tons with an output per man-day of 3.0 tons as compared with 721,864 in 1939 and an output per man-day of 2.4 tons. The company employs about 1,400 men at the mines. The coal mined

is of high volatile "A" bituminous rank, the quality of which varies in the two areas. The ash content in the Comox area is about 12 per cent as compared with 10.7 per cent in the Nanaimo area. Sulphur content in the Comox area is a little over 2 per cent whereas in the Nanaimo area it is 0.4. The calorific value of the Nanaimo coal averages 12,510 B.t.u./lb. as compared with 12,730 in the Comox area. The fusion point of the ash is medium in both areas.

The reserves in the Nanaimo district are rapidly approaching exhaustion and the company now has only two mines operating in this area. The South Wellington No. 10 mine opened in 1937 and is now proceeding with pillar drawing preparatory to closing the mine within two or three years. The White Rapids mine, which works the Wellington seam, was opened in 1945 to recover a local pocket of coal. The seam section runs from 34 to 50 inches in thickness and is mined by longwall methods. Depending on roof and floor conditions, the seam is undercut or overcut on walls 300 feet long. The coal is hand-loaded on shaking conveyers. Duckbills and shortwall cutters have been used for entry driving. The coal is screened at the tipple. Sizes over 2 inches are hand picked and the smaller sizes transported to a washery operated by the company at Nanaimo. The life of the mine is limited to about four or five years.

In the Comox area, the company operates two collieries in the Cumberland area and is presently prospecting in the T'Sable River area. In the Cumberland area only three seams have been workable. They range in thickness from 2.5 feet to 10 feet and vary greatly in quality. The seams have been extensively worked and all the easily accessible coal has been mined. Characteristically, they contain bands of stone and shale and are frequently terminated by barren patches. Both the mines operated by the company are shaft mines and, in both, the longwall mining system is used. Air driven cutters and shaking conveyers are employed. In No. 5 mine, the haulage slope is 12,000 feet down the dip with three relays. The operation is now so extended that it is unprofitable and abandonment is contemplated. No. 8 mine, previously closed in 1914, was re-opened in 1936 and has since been in steady operation. A cross measure tunnel is now being driven to a proven area in a lower seam. It is anticipated that this will extend the life of the mine for a further period. If the T'Sable River deposit which currently is being prospected proves to be a workable area of coal, the mine site will be reasonably close to the Company's cleaning plant and shipping facilities at Union Bay, to which the coal from the mines in the Cumberland area is normally taken. Until the reserve situation has been clearly established, the Company has refrained from installing new equipment and is fully aware of the handicaps arising out of this practice. Improved equipment will be installed if the reserves of the new areas prove adequate.

CHAPTER IV

FINANCIAL ASPECTS OF PRODUCTION

The Commission considered it desirable to undertake a financial review of the coal mining industry in Canada. A study was made of the operating results of the larger companies over a fifteen-year period (1930 to 1944) in order to secure sufficient information for an appreciation of the financial problems presently confronting the industry. In this chapter is presented the results of the study.

The accountants retained by the Commission proceeded with the study from financial information submitted by the companies in response to a questionnaire. No audit was undertaken. Financial information was received from seventy-one companies distributed as follows:

Province	Number of Companies	Percentage of Coal Mined (1943)
Nova Scotia—		
Cape Breton Island	6	100.0
Cumberland County	4	99.0
Pictou County	3	100.0
New Brunswick	7	89.2
Saskatchewan	4	87.0
Alberta—		
Bituminous Mines	9	100.0
Sub-bituminous	9	98.4
Lignite	26	78.0
British Columbia—		
Vancouver Island	1	98.0
Mainland	1	10.0
Crow's Nest Pass	1	100.0
	71	

The accountants submitted to the Commission detailed comparative financial statements for these companies and these have proved of considerable value in familiarizing the Commission with the financial and historical background of the industry.

The fifteen-year period studied has been divided into the following periods:

1930 to 1935—Depression Period
1936 to 1939—Normal or Standard Period
1940 to 1944—War Period

The first part of the chapter deals with the financial aspects of the companies by fields or areas, supplemented by significant information for each company. The closing section, or recapitulation, summarizes the financial position of the industry, with observations as to the results. The survey of the companies by fields or areas commences with Cape Breton Island, Nova Scotia, and closes with Vancouver Island.

The word tons refers to short or net tons of 2,000 lbs. unless otherwise stated.

NOVA SCOTIA

COAL MINING SUBSIDIES OF DOSCO

The Dominion Steel and Coal Corporation Limited (formerly British Empire Steel Corporation Limited) and referred to as Dosco, controls, through ownership of common stock, the Dominion Coal Company Limited and its producing subsidiary Cumberland Railway and Coal Company. It also controls, through the medium of Nova Scotia Steel and Coal Company Limited, the Old Sydney Collieries Limited and Acadia Coal Company Limited.

The Dominion and Old Sydney Companies operate in the Cape Breton field, the Cumberland Company at Springhill, and the Acadia Company in the Pictou coal area—all in the Province of Nova Scotia.

As the Dominion Steel and Coal Corporation Limited, its subsidiaries and affiliates, produce the major tonnage (approximately 90 per cent) of the coal raised in Nova Scotia, and approximately 30 per cent of the coal produced in Canada, a somewhat detailed explanation of its history and operations is given herewith.

A chart showing the corporate structure of Dominion Steel and Coal Corporation Limited and its subsidiaries and affiliated companies, as at December 31, 1943, is shown on the opposite page.

The incorporation, history and operating record is now dealt with by individual coal-producing companies.

DOMINION COAL COMPANY LIMITED

This company is controlled by Dosco through the ownership of the total common stock issued. Dosco also owns $401,200 (par value) of the preferred share issue, out of a total of $5,359,975 outstanding as of December 31, 1944.

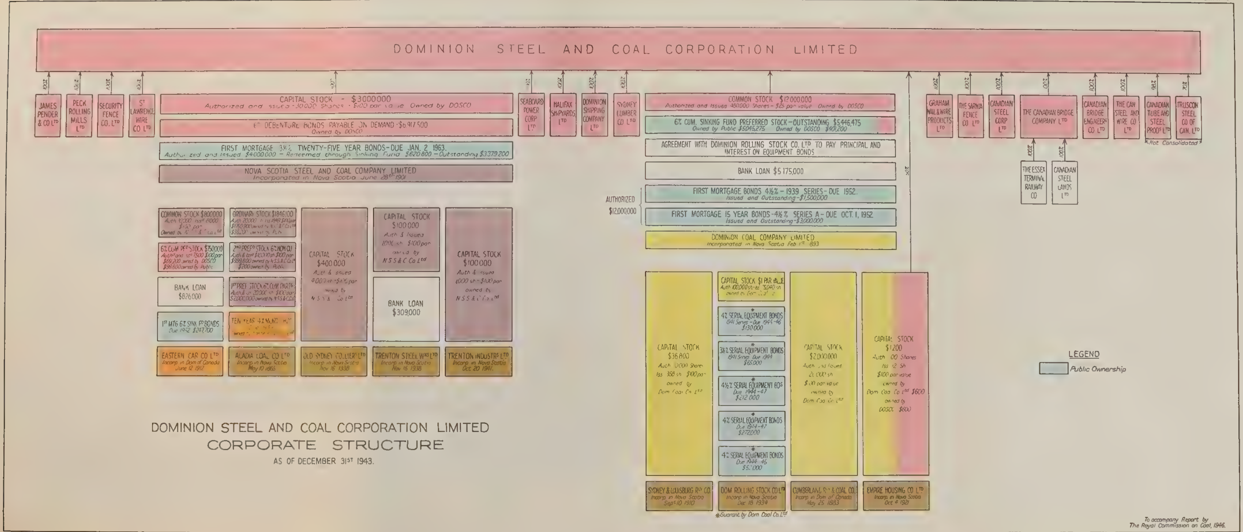
Cumberland Railway and Coal Company, Sydney and Louisburg Railway Company, and Dominion Rolling Stock Company Limited, are fully owned subsidiaries of Dominion Coal, again through the ownership of the common shares. These subsidiaries will be referred to later.

Dominion Coal was incorporated in the year 1893, acquiring all the real and personal property of Mr. H. N. Whitney and associates, including coal mines, equipment, leases, railways, rolling stock, ships, piers, etc. For these properties and $118,750 in cash the Company issued to Mr. Whitney

15,000 8 per cent preferred shares of a par value of $100..	$ 1,500,000
149,650 common shares of a par value of $100...........	14,965,000
	$16,465,000

The remaining 15,000 preference shares were sold to the public, 5,000 of which realized $91 per share in 1896, and 10,000 shares were sold in 1900 at an indicated price of $110 per share. The proceeds of these issues were used for the further development of the properties.

CHART C



DOMINION STEEL AND COAL CORPORATION LIMITED
CORPORATE STRUCTURE
AS OF DECEMBER 31ST 1943.

To accompany Report by The Royal Commission on Coal, 1946.

Various bond issues and changes in the common and preference shares were made in the years intervening between 1893 and 1934, a summary of which is now given.

Common Shares—

In 1893 there was issued for properties, etc.	$ 15,000,000
During 1934 a compromise arrangement was made with the holders of the common and preferred stock, whereby the common shares were reduced by	3,000,000
Leaving the new issue valued at (all of which is owned by Dosco)	$ 12,000,000

No dividends have been paid on the common shares during the fifteen-year period under review.

Preferred Shares—

In 1893 there was issued for properties	$ 1,500,000
and in 1896 and 1900 issued for cash	1,500,000
	$ 3,000,000
The resulting total remained the same until 1934, but in 1905 the dividend rate was reduced from 8 per cent to 7 per cent per annum. Under the compromise arrangement of 1934, the par value of the preferred shares was changed from $100 to $25, and the outstanding issue increased by	3,000,000
The resulting total of	$ 6,000,000
represented 240,000 shares of $25 each.	
These were reduced by shares purchased by the Company and cancelled from 1937 to 1944 of (par value)	640,025
leaving the outstanding preferred stock as at December 31, 1944, standing at	$ 5,359,975
Of the outstanding preferred stock, Dosco owns	$ 401,200
and the public holds	4,958,775
	$ 5,359,975

The above preferred stock was purchased by the Dominion Company as shown below:

—	Par Value Purchased	Cost	Discount
	$	$	$
1938	161,975.00	122,709.60	39,265.40
1939	179,300.00	136,380.39	42,919.61
1940	151,500.00	127,909.00	23,591.00
1941	10,875.00	7,867.00	3,008.00
1942	49,875.00	24,817.95	25,057.05
1944	86,500.00	47,802.49	38,697.51
	640,025.00	467,486.43	172,538.57

The average cost was 73 per cent of par value.

Preferred shares are 6 per cent cumulative from October 1, 1934, preferred as to assets and dividends. They are also entitled to one vote per share, and are subject to call on 60 days' notice at Company's option at 110 per cent of the par value and accrued dividends. There is a sinking fund provision of 1 per cent per annum of the par value of all preference shares issued to commence in 1942, or as soon as the 5 per cent first mortgage bonds were retired. The 5 per cent mortgage bonds were retired in 1937, as referred to later in this report.

Dividends have been paid on the preferred shares up to September 30, 1942, in the years shown below:

1935	$ 360,000.00	1940	$ 331,780.00
1936	451,200.00	1941	164,909.25
1937	360,000.00	1943	409,574.92
1938	352,809.75		
1939	343,695.57		$ 2,773,969.49

The arrears of cumulative dividend amounted to $3.37 per $25 share, or a total of $722,524.63 at the end of 1944. A payment in July, 1946, settled the arrears to December 31, 1943, and also paid the current quarter to June 30, 1946.

Bonds—	Par Value
Prior to March 1, 1893, 6 per cent 20-year first mortgage bonds were sold to the public at 92, in the amount of	$1,500,000
and from 1893 to 1897 there were sold at 93, bonds amounting to	1,500,000
Of the total of	$3,000,000
there was redeemed by sinking fund from 1897 to 1905	565,000
and in 1905 there was retired by a new issue the remaining balance of	$2,435,000
To retire the 6 per cent bonds of $2,435,000 in 1905 and to repay notes payable to Dosco of $2,380,000, there were issued 5 per cent 35-year first mortgage bonds which were sold to the public at 94	$5,000,000
and in 1912 there was sold to the public at par	2,000,000
making a total issue of	$7,000,000
These bonds were redeemed by annual instalments to May 31, 1937, amounting to	$5,519,500
and the remainder retired by a new series "A" 15-year serial bonds bearing 3½ per cent which have been retired in full during the years 1938-1943	$1,480,500
In 1912, 6 per cent cumulative sinking fund debentures were issued to Dominion Steel Corporation at an average price of $83.32 per $100, amounting to (par value)	$3,500,000
which were all redeemed by October 1, 1937, mainly from a new issue of bonds during that year	3,500,000
On October 1, 1937, 3½ per cent first mortgage serial bonds to mature October 1, 1943, in the amount of	$3,000,000
and 4½ per cent 15-year bonds maturing October 1, 1952, in the sum of	3,000,000
making a total of (as at December 31, 1937)	$6,000,000
which were sold at 96, the proceeds being used to retire prior bond issues and to buy the Cumberland Railway and Coal Company from Dosco for $1,000,000.	
A further issue was made in 1939 of the 4½ per cent bonds which were sold at 96.65, with the proceeds being used to provide the Cumberland Company with cash to retire their 5 per cent first mortgage bonds due in 1940 of	1,500,000
	$7,500,000
These bonds have been redeemed at the rate of $500,000 per annum from 1938 to 1943 and $76,000 in 1944, making a total of	$3,076,000
leaving the balance outstanding of (par value) as at December 31, 1944	$4,424,000

From the foregoing summary of bond transactions it will be noted that during the fifteen-year period under review redemption of bonds has amounted to $5,779,000 as under:

Period 1930–1937 (approximately)	$2,703,000
Period 1938–1944	3,076,000
	$5,779,000

Financial Position

The summarized financial position as shown by the consolidated balance sheet (Dominion, Cumberland, Sydney and Louisburg Railway and Dominion Rolling) as at December 31, 1930, and 1944, is undernoted:

—	1930	1944
	$	$
Assets		
Gross Property Value	(a)41,214,186.58	48,830,150.23
Depreciation Reserve	15,331,573.63	26,779,648.18
	25,882,612.95	22,050,502.05
Trustees Cash Balance	138,744.73	640,795.22
Deferred Expenses	321,862.21	325,271.74
Net current position, including amounts due to or from Associated Companies	1,296,489.22	4,411,943.77
	27,639,709.11	27,428,512.78
Liabilities		
Share Capital—		
Common	12,000,000.00	12,000,000.00
Preferred	6,000,000.00	5,359,975.00
Funded Debt—Dominion Coal Co. Ltd.	7,129,500.00	4,424,000.00
Dominion Rolling Stock Co.		519,000.00
	25,129,500.00	22,302,975.00
Reserves	1,440,707.47	3,594,134.55
Surplus	1,069,501.64	(b) 1,531,403.23
	27,639,709.11	27,428,512.78

(a) The fixed assets of Cumberland Railway and Coal Company were not acquired by the Dominion Coal Company Limited until 1937 ($3,645,342.39) and are, therefore, not included in the 1930 position as shown above.

(b) The surplus of $1,531,403.23 at December 31, 1944, is subject to reduction on the payment of arrears of cumulative dividends of $722,524.63 on the preferred shares.

Capital Employed

The ascertainment of the capital employed depends to a large degree on the accuracy by which the value of the assets can be assessed. The most satisfactory way to arrive at this figure, in a company such as Dominion which has so many ramifications and complications in regard to the acquisition of properties and the issue of its capital, is to make an actual physical appraisal of the properties. In the absence of such an appraisal (which it was impracticable for this Commission to undertake), the values must be taken from the books of account of the Company and due weight must be given to the manner by which the assets were acquired—that is, either for a cash or share consideration.

The book values of the properties and other assets owned by the four companies involved as at December 31, 1944, are as follows:

Properties (net)	$22,050,502.05
Trustees Cash	640,795.22
Deferred Expenses	325,271.74
Net Current Position	4,411,943.77
Total capital employed per books	$27,428,512.78

The net properties of $22,050,502.05 are owned by the four companies as under:

Dominion Coal—		
Coal Areas and Leases	$10,567,057.01	
Collieries, Sinkings, Plant and Equipment	6,529,552.93	$17,096,609.94
Cumberland Railway and Coal		2,401,403.49
Sydney and Louisburg Railway		1,454,525.99
Dominion Rolling Company		1,097,962.63
		$22,050,502.05

The Dominion Income Tax Department, for the purposes of fixing a consolidated standard profit for the Company, ascertained the capital employed of the four companies as at January 1, 1939, to be the amount of $13,636,263.53.

The capital employed calculated by the Income Tax Department of approximately $13,600,000 as at January 1, 1939, compares with capital employed arrived at on the book figure of $29,177,095.33 as at the same date. The main difference between these figures is that the Income Tax Department deduct from the book values the amount of bonds then outstanding of $8,471,000, and also deduct from the assets the depletion allowed by that department on coal leases amounting to $7,800,000.

Considerable discussion has taken place with regard to the real value of the coal areas of Dominion Coal, which at December 31, 1944, had a gross book value of $15,111,598.24 and a net book value of $10,567,057.01. This latter figure is included and forms part of the book value of the capital employed of $27,428,512.78.

As reported previously, these leases were acquired at the inception of the Company in 1893, and the available information is that all of the common shares amounting to $15,000,000, together with $1,500,000 preferred shares, were issued for the leases and other assets.

The Board of Referees, in reviewing the claim of the Company for a standard profit, accepted the book figure of coal areas as part of the capital employed. The auditors of the Company, Messrs. Price, Waterhouse and Company, in referring to this item, state "that the balance of fixed assets (coal areas and leases) are the original amounts paid at the incorporation of the Company, plus the accumulations of capital expenditures made since that date, and represent actual out-of-pocket expenditures and have been so accepted by the Income Tax Department."

In awarding production subsidies to these companies, the Emergency Coal Production Board did not allow any depletion charge, usually based at 10 cents per short ton of coal produced as an operating cost. We are informed that the Board follows this procedure where the companies involved are unable to satisfy them that the leases were acquired for cash.

It would, therefore, appear that we have two departments of the Government—namely, the Income Tax which allows as part of the capital employed the amount or value of the leases and, on the other hand, the Emergency Coal Production Board which does not regard the leases as an asset on which depletion should be allowed owing to the inability of the Company to satisfy them as to their cash value.

The following are extracts from a report submitted in 1944 by consulting engineers to the Emergency Coal Production Board, and dealing in this instance with the valuation of coal areas and leases.

> The books of Dominion Coal Company state that the value of coal areas and leases at March 31, 1914, was the amount of total properties less Collieries, Sinkings and Openings, S. & L. Railway, Power Plants, Agencies, etc., as estimated by Appraiser.

Many of the original accounting records of Dominion Coal Company are reported to have been destroyed by fire a few years prior to 1914. For the purpose of determining the value of the fixed properties of the Company, an Appraiser was employed. The book of the Appraiser on file at Sydney indicates that he used actual book costs of the items of property acquired within a few years of the date of the appraisal (March 31, 1914) as shown by odd dollars of value, whereas many of the other presumably older items of property are shown in even hundreds or thousands of dollars. The total appraised value of the collieries, etc., was $18,414,053, the total book value of all fixed properties as of March 31, 1914, was $32,977,437, from which was deducted the amount of the other properties $18,414,053, thus leaving $14,563,384 as the gross value of coal areas and leases. Between 1914 and 1926 net additions to coal areas and leases amounted to $548,215 and, as no additions have been made since 1926, the gross fixed assets represented by coal areas and leases were $15,111,598 as of December 31, 1943.

We have attempted to verify the original cost of the fixed assets, particularly with regard to the coal areas and leases mentioned in the preceding paragraph. The total gross book value of all fixed properties as of March 31, 1914, in amount of $32,977,437 according to our records made in 1925-1926, included $12,739,960 as "discounts on securities, etc.," or goodwill. If the amount of $12,739,960 had been given effect, the value of $14,563,384 would have been reduced to $1,823,424.

It is, therefore, apparent why we do not feel that the amount of $15,111,598 as of December 31, 1943, can be accepted as cost of acquiring the coal areas and leases.

The published balance sheet of Dosco as at December 31, 1945, shows that the investment of that Company in Dominion Coal Company Limited and comprising 480,000 common shares (being all of the issued common shares) and 16,048 preferred shares was carried at the amount of $853,918.81. As the preferred shares had a par value of $401,200 and an approximate market value of $250.000, the value of the common shares in the books of Dosco might be considered as approximately $600,000, which amount could be regarded as the valuation of coal areas in the Dominion Coal Company.

On such a basis of valuation, the capital employed as shown by the books of the four companies involved would be reduced by approximately $10,000,000, bringing the net figure as at December 31, 1944, to approximately $17,500,000, represented by fixed assets of approximately $12,000,000 and liquid assets of approximately $5,500,000.

Reserves

As at December 31, 1944, the companies had reserves amounting to $3,594,134.55, made up as follows:

Betterment and Extensions	$ 2,315,459.16
Subsidence	716,793.15
Contingency	210,782.73
Preferred Stock	172,538.57
Workmen's Compensation Board	19,973.19
Freight Reserve	12,168.62
Sundry	146,419.13
	$ 3,594,134.55

There was also a reserve of $600,194.79 provided for inventory losses, which amount has been deducted from the net current position, and also an amount of $100,000 for freight provision which is carried as an account payable. The total, therefore, of all the reserves carried is $4,294,329.34. Reserve for bad debts of $390,000 appears to be reasonable, in view of the large accounts receivable due to the Company.

These reserves have been built up over the years mainly as charges to operations and, while the amounts are allocated for specific purposes, the actual funds have not been segregated from the other assets of the Company. There has not been a consistent policy adopted by Dominion of making charges to these reserves, and in the last two years the reserves have remained at substantially the same balance.

An illustration of contingencies which would ordinarily be charged to a reserve occurred in the years 1943 and 1944 when the Dominion Company suffered both a fire and flood loss, which cost $294,339.62 in 1943 and $65,321.16 in 1944, both amounts being charged to the operating costs of the year.

In this connection, it is of interest to note that the Acadia Coal Company Limited, which is in the group of companies controlled by Dosco, suffered a fire loss in the amount of approximately $186,000 during the years 1930 to 1932. That Company charged this loss against a reserve set up for that purpose, which had the effect of writing off the amount to operations over a period of seven years.

These reserves may properly be termed an allocation of the surplus account withheld from the shareholders distributable by way of dividends. The equity of the holders (Dosco) of the common shares has, therefore, been enhanced to this extent.

Government Assistance

The Emergency Coal Production Board has assisted Dominion and Cumberland to a larger extent than any other company in Canada.

To the end of 1944 production subsidies have been finalized

at	$10,316,747.17	for Dominion
and	1,112,303.43	for the Cumberland Company
for a total of	$11,429,050.60	

The above subsidy figure represents 69·8 per cent of the total subsidies finalized by the Board to 1944.

Up to March of 1946 further advances have been made of some $3,775,000 on account of 1945 operations.

Wage equalization payments have also been received by Dominion and Cumberland from the Board of $240,311.46, and cost-of-living bonuses from the Commodity Prices Stabilization Board of $1,061,664.10.

Considerable negotiations, audit and investigation work have taken place between government and company officials before the subsidy for 1943 and 1944 was eventually agreed upon in June of 1946.

The original claim was made by the companies as follows:

Dominion	$11,247,877.65
Cumberland	1,391,686.89
	$12,639,564.54

This claim was reduced by the Board by $1,210,513.94 in respect of the years 1943 and 1944 by the undernoted changes:

—	Dominion	Cumberland	Total
	$	$	$
Expenditures of a capital nature	600,392.83	133,318.95	733,711.78
Depletion	615,425.90	109,737.70	725,163.60
Administration	242,749.02	40,896.03	283,645.05
Miscellaneous	23,385.44	3,842.62	27,228.06
	1,481,953.19	287,795.30	1,769,748.49
LESS additional items allowed			
Profit at 15 cents per ton on bunker and export coal	109,511.25		109,511.25
Profit at 10 cents per ton on U.S.A. coal	399,492.80		399,492.80
Depreciation on capital items	41,818.66	8,411.84	50,230.50
	550,822.71	8,411.84	559,234.55
NET DISALLOWANCE	931,130.48	279,383.46	1,210,513.94

DOMINION COAL COMPANY LIMITED—SYDNEY, NOVA SCOTIA

SUMMARY OF OPERATING RESULTS—1930 TO 1944

—	1930 to 1935			1936 to 1939			1940 to 1944			Totals		
	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton
Tonnage Sold	....	Tons 19,420,057	....	....	Tons 16,999,585	....	....	Tons 21,045,597	....	....	Tons 57,465,239	....
Realization	....	$ 92,679,726.45	$ 4.772	....	$ 81,751,623.62	$ 4.809	....	$ 116,363,841.76	$ 5.529	....	$ 290,795,191.83	$ 5.060
Less Agency and Shipping Expenses	....	24,044,316.97	1.238	....	20,945,573.74	1.232	....	31,834,951.39	1.513	....	76,824,842.10	1.337
		68,635,409.48	3.534		60,806,049.88	3.577		84,528,890.37	4.016		213,970,349.73	3.723
Deduct Costs												
Labour	56.028	37,553,927.76	1.934	58.325	33,700,368.43	1.982	60.041	57,146,336.90	2.715	58.368	128,400,633.09	2.234
Material	12.375	8,294,725.90	0.427	10.991	6,350,720.99	0.374	11.216	10,675,010.72	0.507	11.510	25,320,457.61	0.441
Power	7.083	4,747,368.24	0.244	5.819	3,361,946.52	0.198	5.168	4,918,439.37	0.234	5.922	13,027,754.13	0.227
Taxes	1.679	1,125,334.58	0.058	1.244	718,537.91	0.042	0.923	878,421.05	0.042	1.237	2,722,293.54	0.047
Royalties	2.991	2,005,036.79	0.103	3.123	1,804,511.69	0.106	2.232	2,124,584.56	0.101	2.698	5,934,133.04	0.103
Workmen's Compensation Board	1.559	1,044,929.60	0.054	2.430	1,404,041.43	0.083	2.565	2,441,590.04	0.116	2.223	4,890,561.07	0.085
Other Mining Costs	10.094	6,765,491.78	0.348	7.931	4,582,264.83	0.270	10.048	9,563,452.47	0.454	9.506	20,911,209.08	0.364
Administration and Overhead	5.457	3,657,872.22	0.188	3.763	2,174,119.17	0.128	4.028	3,834,163.69	0.182	4.394	9,666,155.08	0.168
	97.266	65,194,686.87	3.356	93.626	54,096,510.97	3.183	96.221	91,581,998.80	4.351	95.858	210,873,196.64	3.669
Depreciation	2.734	1,832,083.36	0.095	6.374	3,683,583.28	0.216	3.779	3,596,442.24	0.171	4.142	9,112,108.88	0.159
Total Cost	100.000	67,026,770.23	3.451	100.000	57,780,094.25	3.399	100.000	95,178,441.04	4.522	100.000	219,985,305.52	3.828
Profit or *Loss* on Operations	....	1,608,639.25	0.083	....	3,025,955.63	0.178	....	*10,649,550.67*	*0.506*	....	*6,014,955.79*	*0.105*
Add Sundry Revenue	....	2,206,510.77	0.114	....	998,698.23	0.059	....	4,000,411.11	0.190	....	7,205,620.11	0.125
Subsidies	....	....	....	....	....	....	....	10,316,747.17	0.490	....	10,316,747.17	0.180
	....	3,815,150.02	0.197	....	4,024,653.86	0.237	....	3,667,607.61	0.174	....	11,507,411.49	0.200
Deduct Bond Interest and Sinking Fund	....	4,742,790.92	0.244	....	1,629,731.97	0.096	....	1,305,240.21	0.062	....	7,677,763.10	0.134
Profit or *Loss* before Taxes	....	*927,640.90*	*0.047*	....	2,394,921.89	0.141	....	2,362,367.40	0.112	....	3,829,648.39	0.066
Income Tax	....	....	....	....	290,000.00	0.017	....	988,515.16	0.047	....	1,278,515.16	0.022
Net Profit or *Loss*	....	*927,640.90*	*0.047*	....	2,104,921.89	0.124	....	1,373,852.24	0.065	....	2,551,133.23	0.044
If Depletion were entered at 10 cents per ton, a further charge would be necessary of	....	1,942,005.70	0.100	....	1,699,958.50	0.100	....	2,104,559.70	0.100	....	5,746,523.90	0.100
Making a Net Profit or *Loss* of	....	*2,869,646.60*	*0.147*	....	404,963.39	0.024	....	*730,707.46*	*0.035*	....	*3,195,390.67*	*0.056*

The final subsidy paid was in respect of—

Operating losses	$ 9,203,178.43
Profit at 15 cents per ton on sales	1,826,379.37
Profit at 10 cents per ton on U.S. coal	399,492.80
Making a total of	$11,429,050.60

The subsidy to Dominion represents 32 cents, 88 cents and $1.67 per ton for the respective years 1942 to 1944, and for the Cumberland Company 67 cents, 49 cents and $1.34 per ton.

Operating Results

The result of the Companies' operations (Dominion Coal, Sydney and Louisburg Railway, and Dominion Rolling Company), as shown by the books and before the provision for income tax and preference dividends, is shown in the following tabulation. With respect to the years 1942, 1943 and 1944, the amounts finalized by the Emergency Coal Production Board are noted, and also the resultant figures after taking these amounts into consideration.

—	Profit or Loss Before Income Tax	Per Ton (short)	Subsidy Finalized	Profit after Subsidy	
				Amount	Per Ton
	$	$	$	$	$
1930	312,483.30 (loss)	0.081 (loss)			
1931	1,350,556.34 (loss)	0.468 (loss)			
1932	539,123.05 (loss)	0.229 (loss)			
1933	155,392.55 (profit)	0.054 (profit)			
1934	629,825.44 (profit)	0.166 (profit)			
1935	489,303.80 (profit)	0.161 (profit)			
1936	586,889.70 (profit)	0.140 (profit)			
1937	644,821.00 (profit)	0.140 (profit)			
1938	422,566.98 (profit)	0.113 (profit)			
1939	740,644.21 (profit)	0.166 (profit)			
1940	1,088,386.46 (profit)	0.213 (profit)			
1941	596,996.08 (loss)	0.133 (loss)	(No charges for depreciation 1941)		
1942	667,189.29 (loss)	0.151 (loss)	1,398,325.88	731,136.59	0.166
1943	2,622,052.99 (loss)	0.729 (loss)	3,181,555.97	559,502.98	0.155
1944	5,156,527.87 (loss)	1.503 (loss)	5,736,865.32	580,337.45	0.170

On the previous page a summary of the operating results is shown, divided into the periods 1930-1935, 1936-1939, and 1940-1944. The first period shows a loss of 4·7 cents per ton, the second a profit of 12·4 cents, and the war years (after subsidy) a profit of 6·5 cents. These results are before any charge for depletion is included.

Capital Expenditures

The Dominion Coal Company have adopted the accounting method which is based on the principle that when a colliery has been put on commercial production all expenditures are classified as operating expenses unless such expenditures:

(1) Increase the initial daily production, or

(2) Decrease the cost of production, or

(3) Increase the available reserves of coal.

An analysis was made of items which are ordinarily capitalized in most Canadian coal companies. By eliminating the cost of those items and substituting therefor depreciation as determined by the engineer to the Board, a variation of the costs as shown by the books resulted. This analysis increased the profit for the years 1943 and 1944 by $26,000 and $89,000 respectively.

Subsequently the Company and the Emergency Board agreed on the amount of the production subsidy, which settlement eliminated items of a capital nature totalling $600,392.83. This amount compares with an original disallowance of $1,316,638.11, the difference of $716,245.28 represented equipment that had a comparatively short life and was accepted by the Board as an operating expense.

The $600,392.83 in equipment expenditures has now been capitalized by Dominion and added to the assets.

Some question has arisen as to whether or not the Dominion and associated companies have been consistent in their accounting treatment throughout the whole of the period under review, or whether there was a change in accounting procedure—particularly with regard to the charging of possible capital expenditures to operations during the years in which the companies were receiving production subsidies.

The records of the companies show that during the period under review the Dominion Company expended the amount of $4,802,580.02 in capital expenditures, and the Cumberland Company the sum of $658,741.08 in the same period. The expenditures took place in the undernoted years:

Year	Dominion Company	Cumberland Company
	$	$
1932	18,110.58	12,633.47
1933	13,728.52	3,353.30
1934	86,329.89	12,027.84
1935	128,510.56	272,334.03
1936	122,181.94	240.54
1937	220,647.70	87,080.00
1938	367,236.89	57,463.73
1939	196,873.55	
1940	1,111,352.50	13,202.42
1941	1,264,169.52	56,063.44
1942	306,297.54	9,833.40
1943	334,702.19*	36,107.71
1944	632,438.64	98,401.20
	4,802,580.02	658,741.08

* After capitalization of amounts disallowed by the Emergency Coal Production Board.

In view of the amount of the expenditures in 1940 and 1941, an analysis of same is given hereunder:—

—	1940	1941
	$	$
Developing and equipping—		
Dominion Colliery No. 18	84,307.93	4,878.77
Dominion Colliery No. 20	40,370.57	3,862.59
Dominion Colliery No. 25	64,481.94	288,196.72
Total Collieries	189,160.44	296,938.08
Agencies (mainly Bridge Bank)	75,380.54	339,360.06
Sanitary Installations	23,935.02	32,241.95
S. & L. Railway (mainly cars)	754,717.49	440,115.68
Shops and Warehouses	68,159.01	155,513.75
	1,111,352.50	1,264,169.52

The accountants to the Commission were not satisfied with the distribution of expenditures, as recorded, during the years when the Company was receiving government subsidy. As mentioned previously, they questioned the propriety of numerous charges to expenses which, in their opinion, should have been added to the assets. It was also possible that considerable development work, the major part of which was labour, was being included as an operating expense.

This whole matter was also the subject of careful enquiry by the Emergency Coal Production Board, which examination has resulted in the decreasing of operating expenses and the increasing of capital assets of the Dominion and Cumberland Companies by the amount of $733,711.78 for the years 1943 and 1944.

In view of the above adjustments which have been accepted by the Companies, we believe that the operating statements as included in this report fairly represent the financial position.

The situation herein discussed emphasizes the need for uniform accounting in the accounts of coal-producing companies.

In discussing the amounts of capital expenditures which have been made and as to whether or not the Companies should have spent more money by way of mechanization and/or capital improvements, there was a suggestion that this could have been accomplished had certain moneys been retained in the treasury instead of being paid out by way of dividends or redemption of bonds.

The records disclose that during the fifteen-year period preferred dividends were paid from 1935 to September 30, 1942, in the aggregate amount of $2,773,969.49. As at July 31, 1946, a further amount of $482,397.75 was paid in respect of preferred dividends for the period October, 1942, to December, 1943, and the current quarter to June 30, 1946. Preferred shares were redeemed from 1938 to 1944 to the par value amount of $640,025.

As mentioned previously in this report, bonds of the Dominion Company have been redeemed during the fifteen-year period in the amount of approximately $5,779,000, of which the sum of $3,076,000 took place during the period 1938 to 1944. This latter redemption was on the basis of $500,000 per year for six years, with the amount of $76,000 in the year 1944. Bonds of the Cumberland Company of approximately $2,200,000 were redeemed between 1937 and 1940.

Bond interest and discount, together with provision for sinking fund payments, have been included in the operating costs during the fifteen-year period as under:

—	Dominion	Cumberland	Total
	$	$	$
Bond interest and discount	4,815,680	1,296,735	6,112,415
Sinking Fund	2,862,083	210,000	3,072,083
	7,677,763	1,506,735	9,184,498

As mentioned previously, no dividends were paid on the common shares during the period under review.

What amounts might be required for mechanization and/or capital improvements is discussed in the chapter on Mining Methods. All of the payments made in respect of redemption of bonds and preference shares have reduced the working capital position of the Company. The payment of accruing bond interest is necessary to meet the contractual obligations of the Company.

Different considerations arise in connection with dividends paid on the 6 per cent cumulative preferred shares. Except for the quarterly dividend for the three months ended June 30, 1946, which has been paid, the dividends on these shares are in arrears for the years 1944 to the first quarter (March 31) in 1946, inclusive. The working capital of this Company is not large in relation to its extensive operations, and if in the future substantial amounts are required for improvements it may appear that payments of preferred dividends for the entire war period might have been withheld and the working capital position thus improved.

Taxes and Royalties

During the period under review the Company has paid taxes, not including income taxes, of $2,722,293.34. In addition, royalties are paid to the Province of Nova Scotia on the basis of 12·5 cents per long ton, resulting in the following payments:

1930–1935	$ 2,005,036.79
1936–1939	1,804,511.69
1940–1944	2,124,584.56
Total royalties	$ 5,934,133.04

Depreciation and Depletion

Depreciation.—In the mining costs of the two coal companies (Dominion and Cumberland) a charge of 20 cents per long ton is made as a provision for depreciation on the fixed assets. For the purposes of the annual profit and loss accounts, however, this provision is reversed and depreciation is calculated on depreciable assets at rates varying from 1 to 10 per cent and for sinkings and openings a tonnage basis is used. In the case of the Cumberland Company, depreciation is based at the rate of 5 per cent of the gross book value of the depreciable assets.

The measure of the depreciation charged for the Dominion Rolling Stock Company is the amount of the annual repayment of the serial bonds issued in respect of the equipment. These repayment provisions are on a basis of 5 and 10 years. As the assets involved have all the same estimated life, the financial statement would be more accurate if the depreciation charges were based accordingly.

The gross book value of the depreciable assets of Dominion Coal and subsidiaries, after eliminating obsolete and fully depreciated assets, amounted to $24,262,562.84 as at December 31, 1944. The total depreciation for the year 1944 as incorporated in the accounts was $1,286,685.59 (which includes $191,146.92 as applicable to coal areas), or 5.3 per cent of the gross value.

At December 31, 1944, the depreciation reserve which had been provided for depreciable assets totalling $24,262,562.84 was $12,345,647.83, or 50.88 per cent of the assets. On the present basis of depreciation, the depreciable assets—viz., plant, equipment and development—will be fully written off in a further 9.2 years. It should be noted that the rates of depreciation adopted by the companies are not in excess of those allowed by the Income Tax Department. After consultation with the mining engineer retained by the Commission, we are of the opinion that the rates for depreciation as charged by the companies are reasonable.

Depletion.—The published financial statements of these companies combine both the depreciable and non-depreciable assets and also the reserve for depreciation (which includes a provision for the write-off of the coal areas). The subsidiary records (plant ledger), however, show the following analysis of the reserve for depreciation as at December 31, 1944:

Assets	Amount	Reserve	Net
	$	$	$
Depreciable	24,262,562.84	12,345,647.83	11,916,915.01
Coal areas	15,111,598.24	4,544,541.23	10,567,057.01
Obsolete or fully depreciated	9,877,350.12	9,877,119.12	231.00
Land	32,340.00	12,340.00	20,000.00
Sundry	453,700.97	....	453,700.97
	48,830,150.23	26,779,648.18	22,050,502.05

In the previous statement as to the amount of the depreciation reserve at December 31, 1944, and which amounted to 50.88 per cent of the related assets, the provision for depreciation or depletion on coal areas was not included as this amount has been allocated by the Company to coal areas. As many coal companies record the depletion allowance in their books, the above allocation has been accepted, although it can be suggested that this whole provision should be regarded as depreciation as shown by the financial statements.

Sales—Dominion Company

During the period under review the percentage of total sales which are made to the public varies from a high of 82 per cent of the total sales in the year 1932 to a low of 56 per cent in the year 1944. The sales to Dosco (Steel Division) range from 6½ per cent in 1932 to 35 per cent in 1944. Company consumption, sales to employees and sundry dispositions average approximately 9 per cent and make up the balance of the total coal sold.

Using the representative years of 1930, 1935, 1939 and 1944, the undernoted tabulation shows the tonnage sold, the percentage of sales of the various grades of coal, and the average price received by the Company from sale to the public, and also sales to Dosco (Steel Division).

PUBLIC SALES

—	1930			1935		
	Tonnage	Percentage	Average Price at Mine	Tonnage	Percentage	Average Price at Mine
			$			$
Round	1,665,096	63.3	....	1,393,477	51.0	....
Nut	....	....	....	....	....	....
Slack	962,361	36.7	....	1,334,375	49.0	....
Public Sales	2,627,457		3.732	2,727,852		3.556
Percentage of Total Sales	....	69.3	....	....	72.8	....
	1939			**1944**		
Round	1,711,918	50.0	3.869	1,198,131	62.35	5.858
Nut	152,569	5.0	4.020	12,533	0.65	4.796
Slack	1,527,859	45.0	3.552	715,401	37.00	4.915
Public Sales	3,392,346		3.732	1,926,065		5.500
Percentage of Total Sales	....	76.3	....	....	56.00	

SALES TO DOSCO (STEEL DIVISION)

—	1930 Tonnage	1930 Percentage	1930 Average Price at Mine	1935 Tonnage	1935 Percentage	1935 Average Price at Mine
			$			$
Round	187,098	25.0	....	119,220	17.5	....
Slack	558,565	75.0	....	557,596	82.5	....
Sales to Dosco (Steel Division)	745,663		3.302	676,816		2.921
Percentage of Total Sales	....	19.7	....	....	18.0	....
	1939			**1944**		
Round	130,153	17.5	3.572	230,924	19.0	4.913
Slack	600,755	82.5	3.126	963,894	81.0	4.431
Sales to Dosco (Steel Division)	730,908		3.206	1,194,818		4.577
Percentage of Total Sales	....	16.4	....	....	34.8	....

The prices to the public up until the year 1940 were competitive with other companies and with United States coal—subject, of course, to the protection enjoyed by Canadian companies through tariff regulations and assistance by way of transportation subventions.

In war years all coal-producing companies were subject to price control, and certain advances in the sale price to the consumer were permitted during that time because of increased labour costs.

The Dominion Government, through the Commodity Prices Stabilization Board, paid to all producing coal companies the difference between increased wages due to cost-of-living bonus and the permitted sales increase. In addition, when the miners were granted a further increase in wages of one dollar per day and a sales price increase of 95 cents per net ton was allowed, the Government paid this Company an amount sufficient to level out the differences involved.

On more than one occasion the suggestion has been made that this Company was selling coal to the Steel Division of Dosco for coking purposes at too low a price, having regard to the realization at the mines for sales in the market generally. This subject was specifically reviewed by a Provincial Royal Commission under the chairmanship of Sir Andrew Rae Duncan in 1926. That it should again arise in the course of our scrutiny of the Nova Scotia industry suggests the desirability of a review of the subject, commencing with the creation of a steel industry at Sydney.

At about the turn of the century the Dominion Iron and Steel Company Limited, established a steel plant at Sydney, using iron ore mined in Newfoundland and contemplating the availability of coking coal from this company at a favourable price. At that time, in particular, the advantageous marketing of slack sizes of coal presented a problem, and the two operations appeared to be complementary to one another. With the establishment of the steel plant in 1899, a contract was entered into between this company and the Dominion Iron and Steel Company Limited, under the terms of which the Steel Company agreed to obtain all coal supplies from the Coal Company, the price to be $1.24 per long ton. The agreement was varied slightly in October, 1903, and this price continued for a further period of six years. After the year 1909 either party was free to seek a readjustment of price and, failing mutual agreement, such

price was to be ascertained by arbitration. From time to time price adjustments were made by mutual agreement, the arbitration provisions of the contract never having been resorted to, so that by 1925 the following prices prevailed:

Slack.......................$3.50 per long ton, or $3.13 per short ton
Run-of-mine...............$4.28 per long ton, or $3.82 per short ton

In 1926, in a jeopardy action taken on behalf of the shareholders of Dominion Iron and Steel Company Limited, the National Trust Company was appointed receiver and manager of the properties of that company and became concerned about the price for coal purchased by it from the Coal Company. The National Trust Company retained the services of two engineers, Messrs. R. V. Norris and Samuel A. Taylor, to enquire into the subject on their behalf, and these engineers collaborated with experts retained by the Coal Company, Col. R. H. Montgomery, of New York, and Cadwallader Evans, of Scranton, Pa. The receiver's experts submitted a full report on the subject and made this specific recommendation—"taking everything into consideration, we believe that the Steel Company should not pay more for this coal than it would net at present if sold on the Montreal market, and the Coal Company should not be asked to sell it for less." For the year 1926 they specifically recommended the following prices:

Screened and run-of-mine.............................$4.28 per long ton
Slack...$3.50 per long ton

The recommendation was accepted by both parties, and in 1927 approved by an order of the Supreme Court of Nova Scotia in the receivership proceedings. It is assumed that from 1926 forwards until the receiver was discharged this formula was followed. This Commission has no specific information as to the prices prevailing between 1926 and 1930.

There are two important factors bearing on the fair price of coal transferred to the Steel plant. Most coal in Nova Scotia contains a high percentage of sulphur—in excess of 2 per cent—whereas in the Pittsburgh area the manufacturers of metallurgical coke (even under conditions prevailing during World War II) would not entertain the use of a coking coal that contained more than 1·25 per cent sulphur. The presence of a large amount of sulphur in metallurgical coke increases the cost of the steel operation, and yet the Steel Company was obliged to compete in the general market with domestic and foreign manufacturers using a better coal. The Steel Company is also a very large customer, using in 1944 approximately 1,200,000 tons—representing about one-third of the total output of the Coal Company—and has on that ground alone the right to expect some price consideration.

At one time the Steel plant as an outlet for slack was considered an important factor, but changed methods of combustion with an extensive use of pulverized fuel have increased the value of slack coal. Taking all factors into consideration, it would appear that the Steel plant is entitled to receive coal used for metallurgical purposes on somewhat more favourable terms than what is realized on public sales.

In the course of our scrutiny of this subject we were informed by the Coal Company that the Norris-Taylor formula was followed from the end of the receivership until 1932, that the Steel Company was given the advantage of special depressed prices up to 1935, and that from about 1935 forwards the Norris-Taylor formula was again resumed—subject to the minor modification that the price would be based upon the average to large customers in the Montreal market, on the ground that it was thought fair to exclude higher prices resulting from small quantity sales. In this connection, the Dominion Coal Company made a submission at our hearings. We here quote part of a memorandum filed by them, which is relevant to this subject—"In the years 1933, 1934, 1935

and 1936 when business was greatly depressed, the Steel Company endeavoured to (and did) obtain considerable export business. To obtain this business it was necessary for the Steel Company to reduce the selling price of its product considerably below the domestic price. An increased production of the Steel Company meant increased coal consumption, and the directors of the Dominion Coal Company agreed to reduce the price of coal supplied and used in the production of steel for export in the amount of forty-five cents per gross ton in the years 1933 to 1936 inclusive, and in the years 1939 and 1940 in the amount of fifty cents per gross ton."

"Effective October 1, 1941, prices were increased by twenty-five cents per gross ton under authority of the Coal Administrator to cover cost of living bonus. On January 1, 1944, prices were increased by $1.06 per gross ton under authority of the Coal Administrator, to cover wages paid to the Dominion Coal Company employees."

The following is a table of sales (long tons) to the Steel Division for the period 1930-1944, with comparative Montreal prices indicated.

Year	Per-cent of Total Sales	Tonnage Sold to Steel Company		Net Price at Mine Charged to Steel Division			Average Montreal Market as Submitted	
		Round	Slack	Round	Slack	Over-all Average	Round	Slack
				$	$	$	$	$
1930	19.6	167,052	498,719			3.698		
1931	12.3	81,739	235,221	Figures		3.661	Figures	
1932	6.5	57,506	77,646	not		3.853	not	
1933	12.4	54,679	263,053	available		3.321	available	
1934	15.0	121,651	386,568			3.256		
1935	18.0	106,446	497,854			3.272	4.23	3.58
1936	18.2	116,764	565,297	3.634	3.134	3.22	4.24	3.60
1937	18.5	141,490	622,988	4.05	3.54	3.637	4.42	3.65
1938	18.3	108,859	504,192	4.25	3.75	3.839	4.42	3.71
1939	16.4	116,208	536,388	4.00	3.50	3.977	4.35	3.71
1940	21.4	164,655	814,134	4.04	3.544	3.629	4.48	3.72
1941	23.7	191,255	757,665	4.381	3.845	3.953	4.394	3.85
1942	27.0	214,072	852,301	4.636	4.096	4.204	Comparative	
1943	25.0	170,907	634,564	4.643	4.103	4.218	market	
1944	*34.8	206,182	860,620	5.564	5.022	5.127	not available	

* In 1944 the Steel Company paid an additional 13.9 cents per ton for round coal and 14.1 cents per ton for slack in connection with wage adjustments, which amounts are not included in the sales figures quoted above.

It is obvious from a study of the above table that from 1930 to 1940 the price of coal sold to the Steel Company was governed by the factors recited in the memorandum and was not based on the formula of Norris and Taylor that the price on the Montreal market should govern. In the year 1941 the formula was resumed and the prices to the Steel Company were so adjusted. The Montreal market, so far as the Coal Company was concerned, ceased to exist about 1942 by reason of war conditions, but the 1941 price (with such price increases as were authorized by the Coal Administrator) continued—and we think properly—to be the measuring stick for sales to the Steel Company. We did not make calculations to show what increased revenue would have accrued to the Coal Company had the Norris-Taylor formula been in operation during the period 1930–1940, as a realistic view of the conditions existing suggests that some variation of this arrangement was necessary.

Summing up this whole subject, it seems manifest that, taking into consideration all the factors that should be weighed, a formula should be arrived at by the interested parties governing the transfer of coal to the Steel Division so that there can be no doubt about the price being one which is fair to both parties. Having regard to the interlocking character of the companies and the

different groups of security holders and employees, this Commission is of the opinion that special measures to ensure that end should be adopted in determining the price of coal transferred to the Steel Division. In 1926 the formula enunciated by the engineers appeared acceptable to all parties, and it is our view that at this time (fully appraising all factors that now prevail) a satisfactory formula could be established.

Sales—Seaboard Power Corporation

During the year 1944 sales of 65,538 tons of slack (16,750 tons) and miscellaneous (48,888 tons splint) were made to the above associated company, resulting in a loss (when sales and cost price are compared) of $85,813.43.

In view of the quality of the coal involved, which was not suitable for other purposes, we do not question the prices involved. The matter is only mentioned as it was discussed in the evidence before the Commission.

United States Coal

During recent years the Company has sold a considerable quantity of coal purchased by them from the United States. The tonnage reached a high figure of 1,964,136 short tons in the year 1944, which approximates the tonnage of Dominion coal sold in the same market prior to the war. It would appear that this condition was due to a declining production in the Nova Scotia mines and also an increased demand for Scotia coal from the steel industry. The net profit realized by the Company on United States coal for 1944 before charging any proportion of administration or selling expense was $438,731.09, or 22.3 cents per ton.

Mining Costs

A significant comparison as to trends in respect of these costs can be obtained from the undernoted tabulation which, using representative years, shows the following costs in short tons:

—	1930	1935	1939	1944
Tonnage Produced	3,852,368	3,639,392	4,498,306	3,361,044
	$	$	$	$
Labour—				
Surface	0.235	0.211	0.210	0.539
Underground	0.869	0.848	0.846	2.101
Mining	0.969	0.852	0.948	1.502
Total Labour	2.073	1.911	2.004	4.142
	$	$	$	$
Material	0.442	0.428	0.360	0.744
Power	0.281	0.206	0.183	0.322
Renewals and Betterments	0.089	0.048	0.103	0.086
General Charges—				
Sundry	0.471	0.401	0.436	0.701
Employees' Benefits	0.069	0.087	0.118	0.368
Banking, Filling and Screening	0.043	0.071	0.030	0.005
Depreciation	0.181	0.161	0.092	0.137
Total Cost (not including depletion)	3.649	3.313	3.326	6.505

In considering the above costs, which are as shown by the books of the Company, it should be noted that because of the treatment given by the Company to the amounts received from the Government for cost-of-living bonus

and the levelling of wages (which sums are credited to sundry revenues) the foregoing costs for the year 1944 would be reduced by approximately 4 cents per ton.

A very important factor in the determination of mining costs is the per-man-day production, and the following tabulation for the production in the representative years is of interest.

—	1930	1935	1939	1944
	Tons per man-day	Tons per man-day	Tons per man-day	Tons per man-day
Surface labour	16.86	17.43	19.42	11.12
Underground labour	5.08	4.86	5.34	3.01
Mining labour	7.11	7.32	7.57	5.99
Total labour—tons per man-day	2.52	2.50	2.70	1.70
Percentage of labour cost to total cost	56.8	57.7	60.2	63.6

From the foregoing production statements it will be seen that the cost of producing coal usually goes up when the per man-day production comes down, as it will be observed from the cost statement above that the labour costs increased from \$2.073 per ton in 1930 to \$4.142 in 1944, or almost 100 per cent, while the per man-day production decreased from 2.52 tons to 1.70 tons.

Included in the mining costs under the classification of "General Charges" during the 15-year period are the following amounts which might be regarded as additional benefits to the employees, but which were not included in the labour costs in the statements submitted.

Loss on coal sold to employees when comparison is made of the sale price with the mining costs as established by the Company	\$ 963,656.13
Workmen's Compensation	4,890,561.07
Relief Associations	410,585.50
Unemployment Insurance	316,772.47
Loss on employees' houses, including rentals written off	279,817.26
Rent and coal to dependents of enlisted men	186,552.57
Vacation pay	280,654.68
Rent balances written off in accordance with McTague Award (charged to reserve for bad debts)	107,390.59

Production

The following production figures for the Dominion Company are of interest when considering the importance of the operations of this Company to the economic welfare of the Province.

Total from 1930 to 1935	19,572,185
Yearly average	3,262,012
Total from 1936 to 1939	17,205,684
Yearly average	4,301,422
Total from 1940 to 1944	20,427,136
Yearly average	4,085,424
Grand Total—1930 to 1944	57,205,005
Yearly average	3,813,667
Year of highest production—1940	4,913,522
Year of lowest production—1932	2,271,008

The total realization of Dominion Coal Company Limited, was approximately \$291,000,000 over the 15-year period, which represents a considerable part of the economy of Nova Scotia.

Sydney and Louisburg Railway

The capital stock of this Company consists of 368 shares of $100 each, or a total of $36,800, all of which is owned by the Dominion Coal Company Limited. The assets represented by the shares issued is the land which is valued at an equal amount, and this is the only capital asset carried on the books of the Railway Company. Included in the properties of the Dominion Coal Company at December 31, 1944, is the amount of $4,625,361.70, representing the capital value of the assets (other than land) of the railway. This value has been depreciated to a net figure of $1,417,725.99 as at the above date.

The Dominion Coal acquired these properties through the original agreement with Mr. H. M. Whitney, which stated that any properties subsequently acquired by him after the negotiation of the original contract would be turned over to the Dominion Company at his cost.

The Company operates, on lease, railway properties of the Dominion Company, and the line extends from connections with the C.N.R. at Sydney to Louisburg on Cape Breton Island.

While the railroad has some revenue other than that derived from associated companies, over 90 per cent of the freight revenue is derived from Dosco products and, therefore, its operations should be considered as part of the operations of the Dominion Company and its results.

After crediting the Dominion Coal Company with an annual amount of $105,000 for investment interest, the undernoted is the final operating result which is incorporated in the books of the Dominion Company:

1937............	$ 32,813.14 profit	1941...........	$195,261.27 loss
1938............	99,621.06 loss	1942...........	408,217.05 loss
1939............	140,742.66 profit	1943...........	467,198.44 loss
1940............	107,963.84 profit	1944...........	615,125.64 loss

In accordance with an agreement between the Dominion Company and the Sydney Steel plant of Dosco, the Sydney and Louisburg Railway carried freight for the Steel plant at a fixed rate of 25 cents per ton. The difference between this figure and the tariff rate is borne by the Dominion Company and is included in the expenses of that Company. During the period under review for the 15 years 1930-1944 inclusive, the amount involved was $213,511.72.

Dominion Rolling Stock Company Limited

This Company was incorporated in 1934 in order to facilitate the financing of purchases of rolling stock—mainly steel hopper cars, which are leased to the Sydney and Louisburg Railway through the Dominion Coal Company. The Rolling Stock Company issues equipment bonds to the public, giving as collateral the security of the asset and the guarantee of the Dominion Coal Company. When the equipment bonds are fully paid, title to the cars passes to the Dominion Coal Company.

In addition to the equipment bonds, common shares to the amount of $75,040 are issued and outstanding, all of which are owned by the Dominion Coal Company Limited.

The annual operating statement of this Company shows a nil balance, as the revenue received by it by way of car rentals is exactly offset by depreciation and interest charges.

SUMMARY

DOMINION COAL COMPANY LIMITED, SYDNEY, N.S.

Incorporated 1893

Capital

Authorized—Common	$ 12,000,000
Preferred	10,000,000
Issued— Common	$ 12,000,000
Preferred	6,000,000
Consideration for issue of Capital—Cash	$ 1,500,000
Properties	13,500,000
Sundry	3,000,000

	1930	1944
Properties—Net Valuation	$ 25,882,613	$ 22,050,502
Net Current Position	1,296,489	4,411,944
Surplus	1,069,502	1,531,403

Earnings Record

Profits—15 years

(a) Before Income Tax	$ 3,829,648	(See Remarks)
(b) After Income Tax	2,551,133	

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ *312,483*	$ 489,304	$ 740,644	$ 580,337
(b) After Income Tax	*312,483*	489,304	540,644	487,837

Dividend Record

Total Dividends Paid—15 years .... $ 2,773,969

Rate on Capital—6 per cent on Preferred, January 1, 1935, to September, 1942.

(In July of 1946 the sum of $482,397.75 was paid, being 6 per cent preferred dividend, October, 1942 to December, 1943, and quarter ended June 31, 1946. In arrears for years 1944, 1945 and first quarter of 1946 at present.) There have not been any dividends paid on the Common Shares.

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 9,112,109	(See Remarks)
Total Depletion (15 years) charged to Operations	—	(See Remarks)

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

(a) Production Subsidies	$ 10,076,436
(b) Wage Equalization	240,311

Total Paid to March 31, 1946

(a) Production Subsidies, including Cumberland Coal Company	$ 15,204,506
(b) Wage Equalization	240,311

Production Record

Total Tonnage—15 years .... 57,205,005 tons

	1930	1935	1939	1944
Annual Production (tons)	3,852,368	3,639,392	4,498,306	3,361,044
Per Man-Day Production (tons)	2.52	2.50	2.70	1.70
Sales Realization per ton—				
Gross	$ 4.77	$ 4.61	$ 4.92	$ 5.98
Net at Mine	3.62	3.43	3.62	5.08
Total Cost—per ton	3.65	3.31	3.32	6.50

REMARKS:—Profits before income taxes as shown above are after charging reserves. A transfer of $400,000 was made in 1937 from an operating reserve to income tax reserve.

Depletion as such is not included in the accounts, although in the property ledger part of the above depreciation is regarded as a provision for the write-off of the valuation placed upon coal areas.

Cumberland Railway and Coal Company

The capital stock of this Company, consisting of 20,000 shares of $100 each or a par value of $2,000,000, was purchased by the Dominion Steel Corporation as at November 1, 1910. The Cumberland Company as at that date had outstanding $979,000 in principal of 6 per cent first mortgage bonds.

Dominion Steel acquired the capital stock of $2,000,000 previously mentioned by issuing in exchange $600,000 par value of its common stock, together with a cash bonus of $12,000. In other words, the Cumberland shareholders received three shares of Dominion Steel Corporation for each ten shares of the old Cumberland Company, together with a cash payment of $6 per share.

The bondholders received $1,200 of new 5 per cent mortgage bonds for each $1,000 of the old 6 per cent bonds. A total of $2,000,000 in new bonds was issued out of an authorization of $3,000,000 for the following consideration:

To redeem outstanding 6 per cent bonds—$1,200 for each $1,000 old bond	$1,174,800
To be issued to Dominion Coal Company Limited for additions and extensions to property	825,200
	$2,000,000

The bonds were guaranteed both as to principal and interest by the Dominion Steel Corporation. Bonds issued to the Dominion Coal Company in consideration of capital expenditures were priced at 90.

The balance of the amount authorized, amounting to $1,000,000, was issued during the period 1912 to 1922 to reimburse the Coal Company for further amounts spent in additions and extensions to the properties of the Cumberland Company, as mentioned in the agreement dealt with hereunder. All of the above bonds which had a sinking fund provision were retired in full by October 1, 1940. The necessary funds for the redemption of these bonds were supplied by the Dominion Coal Company which, for a consideration of $1,000,000, purchased the common shares of Cumberland in August, 1937, and these are still owned by that Company.

By an agreement of 1911, the property was leased to the Dominion Coal Company on the basis of a rental provision, made up of a fixed minimum of $30,000 per year plus half of the annual net earnings. The Dominion Company was also obligated to provide funds for the improvement of the property to be reimbursed by the issue of bonds of the Cumberland Company at 90.

At the end of 1944 Cumberland operated three mines—viz., Nos. 1, 2 and 4 at Springhill, Cumberland County, Nova Scotia—and also owned a railway which connects with the C.N.R. at Springhill Junction and extends to Parrsboro, Nova Scotia.

From the date of purchase in 1937, the assets of the Cumberland Company are included in the consolidated balance sheet of the Dominion Coal Company Limited and subsidiaries, which have been already dealt with in this chapter.

On the facing page is a summary of the operations, which shows that:

For the years 1930–1935 the Cumberland Company made a total net profit, before depletion, of	$ 616,064.82
The above profit is after making the following provisions:—	
Annual rental of $30,000 per year to Dominion Steel Corporation	180,000.00
Proportion of earnings to Dominion Steel Corporation (one-half after sinking fund provisions)	436,064.83
Sinking fund on first mortgage bonds	180,000.00
Making a total profit before the foregoing charges of	$ 1,412,129.65

No depreciation as such is included in the above tabulation, but the figures shown are after bond interest and discount of $773,867.33, as provided by the agreement.

CUMBERLAND RAILWAY AND COAL COMPANY, SYDNEY, NOVA SCOTIA

SUMMARY OF OPERATING RESULTS—1930 TO 1944

	1930 to 1935			1936 to 1939			1940 to 1944			Totals		
—	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton
Tonnage Sold	...	Tons 3,102,916	...	...	Tons 2,319,340	...	...	Tons 3,363,040	...	...	Tons 8,785,296	...
Realization	...	$ 14,374,122.33	$ 4.632	...	$ 10,908,384.65	$ 4.703	...	$ 18,509,339.62	$ 5.504	...	$ 43,791,846.60	$ 4.985
Less Agency and Shipping Expenses	...	1,184,538.35	0.382	...	1,515,406.12	0.653	...	1,902,154.68	0.566	...	4,602,099.15	0.524
		13,189,583.98	4.250		9,392,978.53	4.050		16,607,184.94	4.938		39,189,747.45	4.461
Deduct Costs												
Labour	56.219	6,487,579.44	2.090	58.989	5,478,480.52	2.362	60.652	10,880,174.79	3.235	58.888	22,846,234.75	2.601
Material	11.044	1,274,518.30	0.411	10.974	1,019,202.95	0.439	9.531	1,709,739.78	0.508	10.319	4,003,461.03	0.456
Power	13.393	1,545,556.27	0.498	10.657	989,729.00	0.427	7.682	1,378,062.31	0.401	10.087	3,913,347.58	0.445
Taxes and Rentals	2.479	286,098.31	0.092	2.385	221,457.82	0.095	2.067	370,892.89	0.110	2.264	878,449.02	0.100
Royalties	2.654	306,283.50	0.099	2.487	230,936.05	0.100	1.893	339,610.03	0.101	2.260	876,829.58	0.100
Workmen's Compensation Board	1.582	182,581.11	0.059	2.586	240,172.57	0.104	2.632	472,246.54	0.140	2.307	895,000.22	0.102
Other Mining Costs	8.540	985,568.45	0.318	6.709	623,127.12	0.269	6.043	1,083,988.17	0.322	6.941	2,692,683.74	0.306
Administration and Overhead	4.089	473,367.00	0.152	4.245	422,569.09	0.182	5.760	1,033,327.05	0.307	4.973	1,929,263.14	0.220
	100.000	11,541,552.38	3.719	99.032	9,225,675.12	3.978	96.260	17,268,041.56	5.133	98.039	38,035,269.06	4.330
Depreciation	...	...	...	0.968	90,000.00	0.038	3.740	670,788.26	0.199	1.961	670,788.26	0.087
Total Cost	100.000	11,541,552.38	3.719	100.000	9,315,675.12	4.016	100.000	17,938,829.82	5.332	100.000	38,769,057.32	4.417
Profit or *Loss* on Operations	...	1,648,031.60	0.531	...	77,303.41	0.034	...	*1,331,644.88*	*0.394*	...	393,690.13	0.044
Add Sundry Revenue	...	357,965.38	0.115	...	136,711.40	0.059	...	440,450.41	0.131	...	935,127.19	0.106
Subsidies	...	...	...	...	...	...	...	1,112,303.43	0.331	...	1,112,303.43	0.127
	...	2,005,996.98	0.646	...	214,014.81	0.093	...	221,108.96	0.068	...	2,441,120.75	0.277
Deduct Bond Interest and Sinking Fund, etc.	...	953,867.33	0.307	...	472,318.08	0.204	...	80,550.00	0.024	...	1,506,735.41	0.171
Rental to Parent Company	...	436,064.83	0.141	...	*36,993.23*	*0.016*	...	...	...	...	399,071.60	0.045
Profit or *Loss*	...	616,064.82	0.198	...	*221,310.04*	*0.095*	...	140,558.96	0.044	...	535,313.74	0.061
If Depletion, at ten cents per ton were entered, a further charge would be necessary of	...	310,291.60	0.100	...	231,934.00	0.100	...	336,304.00	0.100	...	878,629.60	0.100
Making the Net Profit or *Loss*	...	305,773.22	0.098	...	*453,244.04*	*0.195*	...	*195,745.04*	*0.056*	...	*343,215.86*	*0.039*

From 1936 to 1939 the Company showed losses which totalled $221,310.04. As the Dominion Coal purchased the Cumberland Company in 1937, the payment of the portion of earnings to Dominion Steel ceased in 1936. The above mentioned loss is after making provision for bond interest of $442,318.08 and $240,000.00 for rentals, sinking fund and depreciation.

An analysis of the years 1940 to 1944 is as follows:

—	Profit (or *Loss*) before Charges	Rentals	Depreciation	Profit (or *Loss*) before Subsidy	Subsidy Finalized	Profit (or *Loss*) after Subsidy
	$	$	$	$	$	$
1940	225,707.05	101,603.52	22,500.00	101,603.53	....	101,603.53
1941	61,742.23	30,871.12	....	30,871.11	....	30,871.11
1942	180,522.82	90,261.41	213,264.48	*123,003.07*	....	*123,003.07*
1943	3,519.64	....	215,051.86	*211,532.22*	312,436.24	100,904.02
1944	*549,711.90*	....	219,971.92	*769,683.82*	799,867.19	30,183.37
	78,220.16	222,736.05	670,788.26	*971,744.47*	1,112,303.43	140,558.96

The above rentals ($222,736.05) were paid to Dominion Coal Company for the years 1940 to 1942, and are included in Mining Costs, under the caption of 'Taxes and Rentals'.

Subsidies claimed by the Cumberland Company, together with their final settlement, have been referred to when dealing with the claims of the Dominion Company.

Sales

Approximately 90 per cent of the coal sold is to the public, including railway and commercial sales, with the remaining 10 per cent being used by the Company for operating or for sales to employees. Using representative years, the undernoted is a tabulation showing an analysis of the sales to the public and the prices received.

—	1930		1935		1939		1944	
	Tons	Per cent	Tons	Per cent	Tons	Per cent	Tons	Per cent
Tonnage—								
Run of Mine	424,313	75	255,603	57	311,175	56	301,689	56
Slack	138,260	25	191,968	43	241,702	44	231,104	44
Total	562,573	100	447,571	100	552,877	100	532,793	100
	$		$		$		$	
Average Price—All Grades	4.60		4.13		4.22		6.04	
Run-of-Mine—								
High	6.12		5.58		5.54		7.08	
Low	4.32		4.35		3.34		5.96	
Average	....		....		4.60		6.41	
Slack—								
High	4.22		3.91		4.06		5.76	
Low	2.53		3.04		3.29		4.76	
Average	....		....		3.68		5.51	

Mining Costs

Using the same representative years as in the case of the sales, the undernoted is a summary of the costs involved in producing the coal.

—	1930	1935	1939	1944
Tonnage produced	634,475	507,242	613,182	595,447
	$	$	$	$
Labour—				
Surface	0.376	0.350	0.308	0.627
Underground	1.036	0.768	0.952	2.337
Mining	0.985	1.052	1.131	1.570
Total Labour	2.397	2.170	2.391	4.534
Material	0.392	0.427	0.391	0.666
Power	0.442	0.473	0.403	0.482
Renewals and Betterments	0.134	0.134	0.134	0.085
General Charges—				
Sundry	0.392	0.398	0.427	0.496
Employees' Benefits	0.092	0.118	0.153	0.438
Banking and Filling	....	0.019	0.003	....
Depreciation	*0.350	*0.350	0.341	0.352
Total Cost	4.199	4.089	4.243	7.053

* Arbitrary amount, as no depreciation as such entered in accounts.

During the year 1944 the Company received from the Dominion Government a refund of the cost-of-living bonus and the levelling of wages, which amounts were credited to sundry revenue and not to the decreasing of the mining costs. The effect of the receipt of this money would be to reduce the mining costs for the year 1944 by approximately 4 cents per ton.

Included in the mining costs noted above are royalties payable to the Provincial Government, which amounted during the 15-year period to $876,829.58 based on 12½ cents per long ton.

Production

The production in tons per man-day for the same representative years is tabulated hereunder, showing the different output by labour classifications.

—	1930	1935	1939	1944
	Tons	Tons	Tons	Tons
Surface Labour	10.0	10.4	13.0	9.9
Underground Labour	3.8	4.9	4.4	2.6
Mining Labour	5.8	4.4	5.0	5.7
Total Labour	1.9	1.9	2.0	1.5
	Per cent	Per cent	Per cent	Per cent
Percentage of Labour Cost to Total Cost	57	53	56	64

The undernoted are the production figures for this Company during the whole period:

	Tons
Total from 1930 to 1935	3,097,161
Yearly average	516,193
Total from 1936 to 1939	2,318,955
Yearly average	579,738
Total from 1940 to 1944	3,362,550
Yearly average	672,508
Grand total	8,778,666
Yearly average	585,244
Year of highest production—1941	735,312
Year of lowest production—1933	434,456

The sales of coal realized the sum of $43,791,846.60 over the 15-year period.

SUMMARY

CUMBERLAND RAILWAY AND COAL COMPANY, CUMBERLAND COUNTY, N.S.

Incorporated 1883

Capital
Authorized—Common .... $ 2,000,000

Issued—Common .... $ 2,000,000

Consideration for issue of
Capital—Cash .... $ 1,000,000 (See Remarks)

	1930	1944
Properties—Net Valuation	Included in Dosco	Included in Dominion
Net Current Position	Included in Dominion	"
Surplus or *Deficit*	"	"

Earnings Record
Profits—15 years
(*a*) Before Income Tax .... $ 535,314
(*b*) After Income Tax .... Consolidated with Dominion

Annual Profit or *Loss*	1930	1935	1939	1944
(*a*) Before Income Tax	$ 163,059	$ 13,789	$ *6,278*	$ 30,183

Dividend Record
Total Dividends Paid—15 years .... $ Nil

Depreciation and Depletion
Total Depreciation (15 years) charged to Operations .... $ 760,788 (See Remarks)
Total Depletion (15 years) charged to Operations .... Nil

Assistance—Emergency Coal Production Board
Included in Accounts to 1944
(*a*) Production Subsidies .... $ 1,112,303

Total Paid to March 31, 1946
(*a*) Production Subsidies .... $ See Dominion Coal

Production Record
Total Tonnage—15 years .... 8,778,666 tons

Production Record—*Concluded*	1930	1935	1939	1944
Annual Production (tons)........	634,475	507,242	613,182	595,447
Per Man-Day Production (tons)..	1.9	1.9	2.0	1.5
Sales Realization—				
Per ton....................	$ 4.60	$ 4.13	$ 4.22	$ 6.04
Total Cost—per ton.............	4.20	4.09	4.24	7.05

REMARKS.—The consideration of $1,000,000 shown for the issue of the common shares represents the cash paid in 1937 by Dominion Coal to Dominion Steel and Coal Company. In 1910 the Steel Company paid $12,000 in cash together with the issue of $600,000 par value in common shares for Cumberland.

Full depreciation, as such, is included in the accounts only for the last three years. Prior to that time depreciation was charged at the rate of $30,000 per year and a like amount was paid as rental to the Parent Company.

ACADIA COAL COMPANY LIMITED, PICTOU COUNTY

History

Acadia Coal Company Limited, operating at present three collieries in Pictou County, Nova Scotia—namely, Allan, Albion and Acadia No. 7—was incorporated under the Companies Act of Nova Scotia in 1865 with an authorized capital stock of $6,000,000.

A revision of the outstanding capital was made in 1913 by calling in the issued shares and exchanging therefor the following:

—	Authorized	Issued
	$	$
First Preferred Six Per Cent Cumulative..................................	2,000,000	2,000,000
Second Preferred Six Per Cent Non-Cumulative..........................	1,000,000	1,000,000
Common..	2,000,000	1,846,100
	5,000,000	4,846,100

Control of Acadia was acquired by the Nova Scotia Steel and Coal Company Limited, in 1919, by the purchase of practically the whole of the outstanding shares at the following cost:

20,000 shares First Preferred 6 per cent Cumulative............	$2,000,000
9,998 shares Second Preferred 6 per cent Non-Cumulative by the issue of $55 in Debenture Stock of Nova Scotia for each $100 par value of Acadia.......................... 17,509½ shares of Common (out of 18,461 issued)..............	974,735
	$2,974,735

Financial Position

A comparative summary of the financial position of Acadia is given in the under-noted balance sheets as at December 31, 1930, and 1944:

—	December 31, 1930	December 31, 1944
	$	$
Assets—		
Properties..	5,428,706	5,302,905
Less reserve for depreciation..........................	1,687,481	3,003,071
	3,741,225	2,299,834
Deferred charges..	103,087	7,084
Net current position, including amounts due or from associated companies..	1,820,726	419,044
Claims..	....	123,623
	5,665,038	2,849,585

—	December 31, 1930	December 31, 1944
	$	$
Liabilities—		
Share capital—		
Preferred—Six Per Cent Cumulative	1,900,000	2,000,000
Six Per Cent Non-Cumulative	1,000,000	1,000,000
Common	1,846,100	1,846,100
	4,746,100	4,846,100
Surplus or *Deficit*	893,520	*2,320,261*
Reserves	25,418	238,746
Four Per Cent Mortgage Bonds	....	85,000
	5,665,038	2,849,585

The Acadia Company has suffered operating losses aggregating some $1,900,000 over the 15-year period, and an additional loss of $1,176,564 was charged to surplus representing amounts due from the Nova Scotia Company. The items making up the foregoing total are:

Coal supplied to Scotia for Trenton Steel *less* contra accounts for steel purchases by Acadia	$ 896,273.00
Interest charged	272,722.00
Cash advances	534,416.00
Charge to surplus—1933	$ 1,703,411.00
Cash payment to Acadia under plan of reorganization by Scotia in 1938	526,847.00
Net loss to Acadia	$ 1,176,564.00

The Acadia Company has paid dividends to the parent company on the 6 per cent cumulative preferred stock for the years 1930 and 1931 only of $228,000.

Properties

The net value of depreciable assets at the end of 1944 was $31,925, all the remaining tangible properties of some $2,500,000 being fully provided for through depreciation charges. The balance of the property account is represented by the value placed upon the coal lands, which at December 31, 1944, stood at a net figure of $2,268,000.

Reserves

The total of the reserves as at December 31, 1944, amounted to $238,746, and the amount appears to be reasonable in view of the size of the operations.

It should be pointed out, however, in view of the large deficit of over $2,000,000, that these reserves, together with part of the provision for depreciation and depletion, have not been earned by the Company.

Government Assistance

For the years 1942 to 1944 the Emergency Coal Production Board has paid to the Company the sum of $1,460,537 in respect of production subsidies.

The original claim by the Company was reduced by $67,253 in the final settlement by the Board. The amount disallowed is practically all represented by an amount for depletion at 10 cents per ton. Unless it can be substantiated that coal areas were purchased for a cash consideration, no depletion charge is allowed by the Board. The above amount of $67,253 has been eliminated from the statements herewith presented, but the Company has not accepted this settlement as final. Levelling of wages assistance from the Board and affiliated companies is entered in the accounts in the amount of $655,114.

The Province of Nova Scotia has also come to the aid of Acadia during the depression years with the following refunds or grants:

Royalties refunded	$ 147,336.00
Capital tax refunded	22,376.00
Workmen's Compensation Board refunded	83,910.00
Wage rate adjustment	20,000.00
Total Provincial Government assistance	$ 273,622.00

A recent announcement has been made that this Company plans to reopen the McBean seam at Thornburn, Pictou County, with a fully mechanized operation.

By Order-in-Council P.C. 1188 dated March, 29, 1946, the Cabinet Committee of the Dominion Government on Reconstruction authorized:—"the Minister of Reconstruction and Supply to make available by way of guaranteed bank loan to Acadia Coal Company Limited such sums not exceeding in the aggregate $730,000 as may be necessary to defray the cost in excess of $250,000 of the opening and development of the McBean seam upon such terms as to security and otherwise as the said Minister may consider to be advisable, and to guarantee to any Chartered Bank or Banks in Canada the repayment of the amounts so loaned and for such purpose to execute and deliver in the name and on behalf of His Majesty such agreements, instruments of guarantee and other documents as the said Minister may consider to be necessary or expedient for the said purpose".

The Commission is informed that the sum of $250,000 above referred to is being advanced to the Acadia Company by the parent company, Nova Scotia Steel and Coal Company Limited.

ACADIA COAL COMPANY LIMITED—STELLARTON, NOVA SCOTIA

SUMMARY OF OPERATING RESULTS—1930 TO 1944

—	1930 to 1935			1936 to 1939			1940 to 1944			Totals		
	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton
		Tons			Tons			Tons			Tons	
Tonnage Sold	....	2,307,984	....	....	1,753,894	....	....	2,228,603	....	....	6,290,481	
		$	$		$	$		$	$		$	$
Realization		10,615,273.24	4.599	....	7,665,313.85	4.370	....	11,047,127.89	4.957	....	29,327,714.98	4.662
Less Freight, Agency and Distribution Expense	....	513,599.86	0.223	....	662,248.12	0.378	....	517,102.5	0.232	....	1,692,950.56	0.269
Net Realization	....	10,101,673.38	4.376	....	7,003,065.73	3.992	....	10,530,025.31	4.725	....	27,634,764.42	4.393
Deduct Costs												
Labour	56.203	6,373,598.02	2.762	56.921	4,594,105.84	2.619	61.846	7,990,707.10	3.585	58.637	18,958,410.96	3.014
Material	9.643	1,093,553.63	0.474	9.906	799,496.77	0.456	9.834	1,270,595.27	0.570	9.785	3,163,645.67	0.503
Power	9.591	1,087,636.72	0.471	10.552	851,652.63	0.486	8.393	1,084,411.21	0.486	9.352	3,023,700.56	0.481
Taxes and Rentals	1.251	141,889.14	0.061	1.179	95,160.10	0.054	0.655	84,635.41	0.037	0.995	321,684.65	0.051
Royalties	1.924	218,187.84	0.095	1.999	161,303.88	0.092	1.631	210,736.11	0.095	1.826	590,227.83	0.094
Workmen's Compensation Board	1.781	202,030.00	0.088	2.575	207,857.51	0.119	3.084	398,461.00	0.179	2.500	808,348.51	0.129
Other Mining Costs	8.762	993,647.05	0.431	7.683	620,076.17	0.354	8.449	1,091,638.90	0.490	8.368	2,705,362.12	0.430
Administration and Overhead	4.191	475,328.52	0.206	3.238	261,324.65	0.149	3.408	440,279.03	0.198	3.640	1,176,932.20	0.187
	93.346	10,585,870.92	4.588	94.053	7,590,977.55	4.329	97.300	12,571,464.03	5.640	95.103	30,748,312.50	4.889
Depreciation and Depletion	6.654	754,648.58	0.326	5.947	480,000.00	0.273	2.700	348,795.69	0.157	4.897	1,583,444.27	0.251
Total Costs	100.000	11,340,519.50	4.914	100.000	8,070,977.55	4.602	100.000	12,920,259.72	5.797	100.000	32,331,756.77	5.140
Loss on Operations	....	*1,238,846.12*	*0.538*	....	*1,067,911.82*	*0.610*	....	*2,390,234.41*	*1.072*	....	*4,696,992.35*	*0.747*
Less Sundry Revenue	....	353,188.58	0.153	....	*5,877.58*	*0.003*	....	59,187.67	0.027	....	406,498.67	0.065
Subsidies	....	....	....	....	....	....	....	1,460,536.83	0.655	....	1,460,536.83	0.232
Levelling Up Wages	....	....	....	....	....	....	....	655,114.23	0.294	....	655,114.23	0.104
Provincial Government Assistance	....	76,352.51	0.033	....	197,269.98	0.112	....	....	....	....	273,622.49	0.043
		429,541.09	0.186		191,392.40	0.109		2,174,838.73	0.976		2,795,772.22	0.444
Net *Loss*	....	*809,305.03*	*0.352*	....	*876,519.42*	*0.501*	....	*215,395.68*	*0.096*	....	*1,901,220.13*	*0.303*

Operating Results

On the facing page a summary of the operations over the 15-year period is shown. The total loss over the period is $1,901,220, or approximately 30 cents per ton.

The Company has been able to finance because of the fact that before the above loss is arrived at depreciation (a non-cash item) of $1,583,444, or 25 cents per ton, has been charged. Together with this fact, it will be noted from the balance sheet analysis that reserves (an additional non-cash item) have increased by some $213,000 and that the current position has declined in the period.

Before government assistance, but including depreciation and depletion of 25 cents per ton, the Company has lost 68 cents per ton in the 15 years under review. This loss increases progressively from 38 cents in the 1930-1935 period to 61 cents in the period 1936-1939, and to $1.05 in the war years.

An analysis has been made of items which may be deemed to be of a capital nature which were charged to operations over the period. By eliminating these items and substituting depreciation charges, the resulting adjustment would have the following effect on the profit and loss account for the designated years:

—	Result as shown	Adjustment		Final Result
		Amount	Per Ton	
	$	$	$	$
1941	*62,470.96*	28,740.96	0.054	*33,730.00*
1942	5,000.00	55,132.85	0.127	60,132.85
1943	*28,618.06*	*2,309.70*	*0.006*	*30,927.76*
1944	*28,635.30*	*20,366.09*	*0.058*	*49,001.39*

Using the period 1936-1939 as a base of 100, the comparison with prior (1930-1935) and the subsequent (1940-1944) periods for sales realization and cost is:

—	Sales	Costs
1930–1935	109.6	106.8
1936–1939	100.0	100.0
1940–1944	118.3	126.6

Sales

A comparison of the distribution of coal produced during the representative years is as follows:

Year	Public Sales	Sales to Associated Companies	Company Consumption and Employees
	Per cent	Per cent	Per cent
1930	81.5	8.1	10.4
1935	72.6	5.8	21.6
1939	71.2	6.8	22.0
1944	60.3	17.0	22.7

Using the representative years, the undernoted is a summary of the tonnage and prices received at the mine for public sales (short tons):

—	1930		1935		1939		1944	
	Tons	Per cent	Tons	Per cent	Tons	Per cent	Tons	Per cent
Tonnage—								
Run-of-mine	382,484	94	257,352	90	266,612	81.5	191,399	90
Slack	23,414	6	29,145	10	60,152	18.5	21,793	10
Total	405,898	100	286,497	100	326,764	100	213,192	100
	Per cent		Per cent		Per cent		Per cent	
Percentage to total sales	81.5		72.6		71.2		60.3	
Price—	$		$		$		$	
Run-of-mine	.....		.....		.....		6.59	
Slack	.....		.....		.....		5.28	
Average	4.91		4.25		4.20		6.45	
Run-of-mine	$		$		$		$	
Highest price	6.13		5.05		5.23		7.08	
Lowest price	3.71		3.83		3.79		6.11	
Slack—								
Highest price	3.72		3.41		3.60		5.37	
Lowest price	3.22		3.22		3.47		5.30	

The related sales to associated companies are also given hereunder:

—	1930		1935		1939		1944	
	Tons	Per cent	Tons	Per cent	Tons	Per cent	Tons	Per cent
Tonnage—								
Run-of-mine	17,413	41	11,115	43	16,155	46	8,296	14
Slack	25,365	59	14,606	57	18,779	54	51,612	86
Total	42,778	100	25,721	100	34,934	100	59,908	100
	Per cent		Per cent		Per cent		Per cent	
Percentage to total sales	8.1		5.76		6.8		17.0	
Prices—	$		$		$		$	
Average	4.13		4.11		4.18		5.48	
Run-of-mine—								
Highest price	4.41		4.50		4.54		6.30	
Lowest price	2.56		3.13		4.06		6.24	
Slack—								
Highest price	4.01		4.00		4.00		5.45	
Lowest price	3.58		4.00		3.95		5.45	

Mining Costs

The mining costs of Acadia are very high, the above index showing a rise of 26.6 points for the war years. The outstanding contributing factor appears to be the very low per-man-day production, which in 1944 was 1.15 tons per man day.

The costs per ton for some recent years by collieries (as shown by the cost sheets) is as follows:

—	Allan	Albion	Acadia 7	All Collieries
	$	$	$	$
1936	4.806	4.836	3.898	4.691
1939	4.276	4.408	3.122	4.130
1942	7.215	5.305	4.240	5.620
1944	10.298	8.594	8.982	9.243

In the above costs depreciation and depletion are included at 20 cents per long ton, or 18 cents per short ton.

Of the total coal raised, Allan Colliery produces approximately 36 per cent, Albion 52 per cent and Acadia 7 about 12 per cent.

A comparative analysis of the mining costs for selected years is as follows:

—	1930	1935	1939	1944
Tonnage produced	506,754	392,321	459,013	353,559
	$	$	$	$
Labour—				
Surface	0.494	0.444	0.400	1.122
Underground	1.179	1.191	0.986	3.148
Mining	1.231	1.005	1.044	1.759
	2.904	2.640	2.430	6.029
Material	0.529	0.498	0.428	0.821
Power	0.326	0.511	0.445	0.678
Renewals and betterments	0.051	0.089	....	....
General charges—				
Sundry	0.604	0.640	0.494	0.903
Employee benefits	0.134	0.173	0.153	0.634
	4.548	4.551	3.950	9.065
Depreciation and depletion as per profit and loss account	0.237	0.306	0.261	0.094
Total cost	4.785	4.857	4.211	9.159

The above per-ton costs of $9.159 for the year 1944 are as shown by the records of the Company. During this year, however, the Dominion Government reimbursed the operator for certain special costs in respect of:

(a) Cost of living bonus.

(b) Levelling of wages.

(c) Excess of increased wages.

The aggregate of these amounts was equivalent to 88.2 cents per short ton and was recorded by the Company as "sundry revenue". As these amounts are, in fact, reimbursements of special costs, the mining costs for that year should be stated as $8.277 per short ton.

Because of the adjustments for certain capital expenditures previously referred to, the 1944 per-ton costs should be increased by a further 5.8 cents to a total for that year of $8·335.

Royalties

Included in these mining costs are royalties to the Provincial Government at $12\frac{1}{2}$ cents per long ton, as follows:

1930–1935	$ 218,187.84
1936–1939	161,303.88
1940–1944	210,736.11
	$ 590,227.83

Production

The production (in tons per man day) for the representative years which have been used is as follows:

—	1930	1935	1939	1944
	Tons	Tons	Tons	Tons
Surface labour	7.77	7.30	8.05	5.44
Underground labour	3.44	2.87	3.47	1.98
Mining labour	4.94	4.64	5.32	5.64
Total labour	1.61	1.42	1.67	1.15
	Per cent	Per cent	Per cent	Per cent
Percentage of labour to total cost	60.6	54.3	57.7	65.8

The production figures for the Company during the period under review are as hereunder:

	Short Tons
Total from 1930 to 1935	2,307,071
Yearly average	384,512
Total from 1936 to 1939	1,754,260
Yearly average	438,565
Total from 1940 to 1944	2,230,687
Yearly average	446,136
Grand total	6,292,018
Yearly average	419,468
Year of highest production—1940	531,201
Year of lowest production—1933	233,163
Total sales realization	$29,327,715

SUMMARY

ACADIA COAL COMPANY LIMITED, STELLARTON, N.S.

Incorporated 1865

Capital			
Authorized—Common	$ 2,000,000		
Preferred	3,000,000		
Issued— Common	$ 1,846,100		
Preferred	3,000,000		
Consideration for issue of Capital—Cash	$ 2,974,735	(See Remarks)	
	1930	1944	
Properties—Net Valuation	$ 3,741,225	$ 2,299,834	
Net Current Position	1,820,726	542,667	
Surplus or *Deficit*	893,520	*2,320,261*	

Earnings Record

Losses—15 Years

(a) Before Income Tax.......................................$ *1,901,220*

(b) After Income Tax....................................... *1,901,220*

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax.........	$87,418	$ *287,377*	$ *137,911*	$ *28,635*
(b) After Income Tax............	87,418	*287,377*	*137,911*	*28,635*

Dividend Record

Total Dividends Paid—15 years.......................................$ 228,000

Rate on Capital—6 per cent for two years on $1,900,000 of First Preferred Shares.

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations.......................
Total Depletion (15 years) charged to Operations........................ } $ 1,583,444

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

(a) Production Subsidies.......................................$ 1,015,149

(b) Wages Equalization....................................... 445,388

Total Paid to March 31, 1946

(a) Production Subsidies.......................................$ 2,474,303

(b) Wages Equalization....................................... 445,388

Production Record

Total Tonnage—15 years....................................... 6,292,018 tons

	1930	1935	1939	1944
Annual Production (tons).........	506,754	392,321	459,013	353,559
Per Man-day Production (tons)...	1.61	1.42	1.67	1.15
Sales Realization—per ton........	$ 4.91	$ 4.25	$ 4.20	$ 6.45
Total Cost—per ton.............	4.78	4.86	4.21	8.28

REMARKS.—Purchase of Acadia by Nova Scotia was made by paying cash in the amount of $2,000,000 for the first preferred shares and by the issue of $974,735 in debentures for the balance of the preferred and practically the whole of the common shares.

OLD SYDNEY COLLIERIES LIMITED

History

The mines presently operated by Old Sydney were for many years the coal-producing department of Nova Scotia Steel and Coal Company Limited, hereinafter referred to as the Scotia Company.

Early in 1933 the Scotia Company, having failed to pay the interest on its First Mortgage Bonds and 6 per cent Debenture Stock, was placed in receivership by the holders of those securities.

The receivers, together with liquidators acting on behalf of shareholders, managed the Company until July 31, 1938, when a plan of reorganization was accepted by the bond and shareholders and approved by the court.

Under this plan separate companies were formed to transact the business of the classes of enterprise previously operated by Scotia, Old Sydney Collieries Limited being the coal-producing company.

Old Sydney, after incorporation on August 1, 1938, issued 4,000 shares of $100 each, or $400,000, to the Scotia Company, receiving in exchange net assets valued at $1,002,068.61—that being the capital employed by Scotia in its coal operations, the details of which are as follows:

Cash	$ 137,256.63
Accounts receivable	121,272.23
Inventories of coal and supplies	411,193.17
Due from other companies	467,407.20
Deferred charges	49,962.94
	$ 1,187,092.17
Less: Liabilities	185,023.56
Net assets turned over to Old Sydney	$ 1,002,068.61

As Old Sydney did not acquire any coal properties, it entered into a rental agreement with Scotia, leasing the Princess and Florence collieries, shipping pier, buildings, plant, etc., for an annual rental of $60,000, together with an undertaking to properly maintain the property and to pay all taxes, lease rentals, royalties, etc.

This agreement was subsequently amended, under which amendment Old Sydney paid in addition to the foregoing rental a depletion charge of 10 cents per ton, commencing January 1, 1942.

Properties

The book value of the leased properties on the records of Scotia at the end of 1944 was a net amount of $3,225,498.11, summarized as follows:

At the date of reorganization of Scotia, these properties had a book value of	$ 7,984,204.13
From which accumulated depreciation was written off in the amount of	2,476,632.28
Leaving a net book value of	$ 5,507,571.85
Which was further adjusted by charging to surplus	2,303,972.68
Resulting in a valuation as at August 1, 1938 of	$ 3,203,599.17
Expenditures on capital account have been made to December 31, 1944, of	21,898.94
Making the net book value as of that date	$ 3,225,498.11

For the operating use of the above properties Old Sydney has paid:

—	Rental and Depletion	Taxes and Insurance	Royalties	Total	Annual Percentage to Book Value
	$	$	$	$	Per cent
1938	25,000.00	25,018.10	33,214.80	83,232.90	6.2 (5 mos.)
1939	60,000.00	57,892.20	78,984.32	196,876.52	6.1
1940	60,000.00	59,328.00	86,523.01	205,851.01	6.4
1941	60,000.00	59,324.00	93,888.87	213,212.87	6.6
1942	117,345.90	59,044.96	91,725.57	268,116.43	8.3
1943	113,628.00	59,511.50	75,096.54	248,236.04	7.7
1944	112,944.40	57,410.29	79,200.27	249,554.96	7.7
	548,918.30	377,529.05	538,633.38	1,465,080.73	

In addition to the above charges, Old Sydney has maintained the properties and has installed equipment which will be discussed later.

OLD SYDNEY COLLIERIES LIMITED, STELLARTON, NOVA SCOTIA

SUMMARY OF OPERATIONS—1930 TO 1944

—	1930 to 1935			1936 to 1939			1940 to 1944			Totals		
	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton
		Tons			Tons			Tons			Tons	
Tonnage Sold	....	3,199,928	....	....	2,687,532	....	....	3,588,997	....	....	9,476,457	....
		$	$		$	$		$	$		$	$
Realization	....	15,297,675.52	4.781	....	13,232,757.86	4.924	....	21,417,703.59	5.968	....	49,948,136.97	5.271
Less Agency and Shipping Expense	....	3,439,132.77	1.075	....	3,142,693.72	1.169	....	4,901,524.38	1.366	....	11,483,350.87	1.212
		11,858,542.75	3.706		10,090,064.14	3.755		16,516,179.21	4.602		38,464,786.10	4.059
Deduct Costs												
Labour	55.786	7,166,966.67	2.240	58.571	6,225,262.93	2.316	61.674	9,737,822.93	2.712	58.907	23,130,052.53	2.441
Material	11.718	1,505,481.57	0.470	13.187	1,401,572.74	0.522	13.346	2,107,275.24	0.587	12.770	5,014,329.55	0.529
Power	8.360	1,073,986.86	0.336	6.890	732,314.32	0.272	6.038	953,399.14	0.266	7.028	2,759,700 32	0.291
Taxes and Rentals	2.627	337,538.56	0.105	2.080	221,104.06	0.082	1.762	278,211.00	0.078	2.131	836,853.62	0.088
Royalties	2.557	328,533.14	0.103	2.757	293,034.63	0.109	2.701	426,434.26	0.119	2.669	1,048,002.03	0.111
Workmen's Compensation Board	1.609	206,770.38	0.065	2.246	238,754.10	0.089	2.629	415,054.89	0.116	2.192	860,579.37	0.091
Other Mining Costs	8.361	1,074,117.86	0.336	6.672	709,109.71	0.264	9.046	1,428,315.31	0.398	8.179	3,211,542.88	0.338
Administration and Overhead	4.519	580,578.31	0.181	3.087	328,057.04	0.122	2.804	442,724.86	0.123	3.442	1,351,360.21	0.143
	95.537	12,273,973.35	3.836	95.490	10,149,209.53	3.776	100.000	15,789,237.63	4.399	97.318	38,212,420.51	4.032
Depreciation	4.463	573,369.00	0.179	4.510	479,334.80	0.178	....	....	....	2.682	1,052,703.80	0.110
Total Cost	100.000	12,847,342.35	4.015	100.000	10,628,544.33	3.954	100.000	15,789,237.63	4.399	100.000	39,265,124.31	4.142
Operating Profit or *Loss*	....	*988,799.60*	*0.309*	....	*538,480.19*	*0.199*	....	726,941.58	0.203	....	*800,338.21*	*0.083*
Add Sundry Revenue	....	671.51	....	....	3,522.51	0.001	....	60,589.27	0.017	....	64,783.29	0.007
Provincial Government Assistance	....	39,929.38	0.013	....	....	....		....	....	....	39,929.38	0.004
		948,198.71	*0.296*	....	*534,957.68*	*0.198*	....	787,530.85	0.220	....	*695,625.54*	*0.072*
Deduct Bond Interest	....	939,353.26	0.294	....	400,880.11	0.149	....	....	....	....	1,340,233.37	0.141
Rental	....	....	....	....	....	....	....	463,918.30	0.129	....	463,918.30	0.049
		1,887,551.97	*0.590*	....	*935,837.79*	*0.347*		323,612.55	0.091	....	*2,499,777.21*	*0.262*
Deduct Income Tax	....	....	....	....	....	....	....	93,841.03	0.026	....	93,841.03	0.010
Net Profit or *Loss*	....	*1,887,551.97*	*0.590*	....	*935,837.79*	*0.347*	....	229,771.52	0.065	....	*2,593,618.24*	*0.272*

Financial Position

The financial position of the Company as at August 1, 1938, and December 31, 1944, is set out in the undernoted balance sheet:

—	August 1, 1938	December 31, 1944
	$	$
Assets—		
Net current position, including amounts due from associated companies..	952,105.67	1,387,783.34
Deferred	49,962.94	16,037.14
	1,002,068.61	1,403,820.48
Liabilities—		
Share capital	400,000.00	400,000 00
Reserves	602,068.61	740,494.59
Surplus		263,325.89
	1,002,068.61	1,403,820.48

Old Sydney is in a sound financial position, as its net current position at December 31, 1944, was $1,387,783.34.

During the period 1938-1944, this Company, according to its own records, has built up a surplus of $263,325.89 after provision of $93,841.03 for income taxes and increasing reserves by $138,425.98. Certain adjustments, which are referred to later in this report, would substantially increase the surplus amount.

Operating Results

On the previous page is a summary of the operating results of these mines, divided into the three periods (1930-1935), (1936-1939) and (1940-1944). A total loss of $2,593,618.24 is shown.

A further analysis of this loss by the various periods of management is:

Years 1930 to 1932—

Operated as a department of the Scotia Company and under its management .... loss $1,306,717.26

Included in the above loss is an apportionment of bond interest amounting to $473,966.24.

Years 1933 to July 31, 1938—

Operated as a department of the Scotia Company and under the management of the receivers and liquidators .... loss 1,550,226.87

Apportionment of bond interest included in loss was $866,267.13.

Total loss to Scotia Company $2,856,944.13

Years (August 1) 1938 to 1944—

Operated as a separate company (Old Sydney Collieries Limited) under its own management.

Profit .... $ 357,166.92

Less income tax 93,841.03

263,325.89

Total loss over 15 years .... $ 2,593,618.24

The bond interest referred to above was settled under the reorganization plan by the issue of Dosco B shares.

A survey of the operating charges subsequent to 1939 has been made, which has resulted in certain of the charges being classified as capital or deferred. As this Company does not own the properties but leases them from Scotia, any capital charges should be written off over a determined period of time. The operating accounts as submitted have, therefore, been adjusted by allowing depreciation or amortization in respect of such capital items.

In addition, it would appear that the Company's original current reserves of some $600,000 would be sufficient to meet any contingency and, therefore, the increase in the reserves (which was charged as an expense) has also been reversed in the undernoted statement, which shows the profit or loss before income tax, the above explained adjustments and the resulting net profit.

—	Profit or *Loss* Before Income Tax	Eliminations	Resulting Net Profit
	$	$	$
1939	16,646.52	103,553.41	120,199.93
1940	*28,604.37*	90,302.29	61,697.92
1941	*57,329.19*	129,015.60	71,686.41
1942	226,542.86	83,856.61	310,399.47
1943	167,029.24	84,652.13	251,681.37
1944	15,974.01	83,915.05	99,889.06
	340,259.07	575,295.09	915,554.16

From the foregoing it would appear that during the years 1939 to 1944 Old Sydney enjoyed a very favourable earning experience.

This Company has not claimed or received any production subsidies from the Emergency Coal Production Board.

Sales

Sales to the public constitute approximately 90 per cent of the total tonnage sold for all years, except in the years 1931 and 1943 when 23 per cent and 35 per cent, respectively, was sold to the Dominion Coal and Steel Corporation (Steel Division). The remaining 10 per cent is used by the Company for operating purposes or sold to employees and to other associated companies.

Sales—Dosco (Steel Division)

The sales to the Steel Division of Dosco over the period from 1930 to 1944 resulted in a loss of $260,873.39, when the price received at the mines is compared with the mining costs as computed by the Company. This amount is divided as between operations as follows:

1930–1938	$ 220,207.58
1939–1944	40,665.81
	$ 260,873.39

Insofar as the present Company has only operated since August, 1938, the loss of $40,665.81 is further analyzed:

Year	Loss	Tonnage sold to Dosco (Long Tons)		Selling Price to Dosco (Long Tons)		Selling Price to Public (Long Tons)	
		R/M	Slack	R/M	Slack	R/M	Slack
	$			$	$	$	$
1939	880.68	7,339	....	4.151	....	4.437	4.078
1940	4,322.71	8,345	....	4.007	....	4.582	3.988
1941	3,839.63	6,213	....	4.125	....	4.852	4.053
1942	18,398.64	1,689*	27,976	4.180	4.183	5.734	4.471
		3,848†	....	4.478	....		
1943	5,058.89	31,712*	175,330	5.734	5.434	6.025	5.270
		3,745†	....	4.254	....		
1944	8,165.26	4,934*	....	6.179	....	7.206	5,989
		6,470†	....	5,269	....		
Totals	40,665.81	74,295	203,306				

* Rail. † Water.

The matter of sales to the Steel Division of Dosco by the Dominion Coal Company has been dealt with at length in the report of that Company.

By comparison, it will be noted that Old Sydney received a higher price for coal sold to the Steel Division of Dosco than does the Dominion Coal Company, which is an associated company. In the year 1943 Old Sydney sold 175,330 tons of slack to Dosco (Steel Division) and received $5.434 per ton compared with $4.103 received by the Dominion Company for 634,564 tons, while the price to the public was $5.27. In the year 1942 Old Sydney sold 27,976 tons of slack to the Steel Division at $4.183 per ton compared with $4.096 received by the Dominion Company for 852,301 tons of slack.

As Old Sydney, like the Dominion Coal Company, is controlled by Dosco, it is our view that what has already been said in our review of Dominion Coal Company Limited about a price formula has application to sales by this Company to Dosco.

Sales—Public

For representative years, a summary of tonnage sold and prices received at the mines for public sales is as follows:

—	1930		1935		1939		1944	
	Tons	Per cent	Tons	Per cent	Tons	Per cent	Tons	Per cent
Tonnage—								
Run of mine	315,751	64	350,269	64	399,608	64	357,643	58
Slack	176,934	36	196,658	36	229,011	36	263,801	42
Total	492,685	100	546,927	100	628,619	100	621,444	100
	$		$		$		$	
Price—								
Run-of-mine	....		3.567		3.961		6.434	
Slack	....		3.391		3.641		5.348	
Average	4.158		3.553		3.848		6.000	
Run-of-mine—								
Highest Price	5.590		4.964		5.358		7.240	
Lowest Price	3.653		3.331		3.681		5.742	
Slack—								
Highest Price	3.492		3.810		4.647		6.555	
Lowest Price	2.420		2.844		2.544		4.186	

Mining Costs

A comparative analysis of the mining costs for selected years is shown hereunder:

—	1930	1935	1939	1944
Tonnage produced	567,132	609,849	681,508	682,850
	$	$	$	$
Labour—				
Surface	0.372	0.269	0.276	0.562
Underground	0.994	0.814	0.823	1.393
Mining	1.400	1.064	1.177	1.518
	2.766	2.147	2.276	3.473
Material	0.492	0.460	0.488	0.733
Power	0.395	0.300	0.259	0.278
Renewals and Betterments	0.035	0.089	....	0.053
General Charges—				
Sundry	0.542	0.648	0.418	0.631
Employees' Benefits	0.119	0.105	0.112	0.301
Banking and Filling	0.062	0.076	0.082	0.064
	4.411	3.825	3.635	5.533
Rental or Depreciation	0.178	0.178	0.178	0.165
	4.589	4.003	3.813	5.698

As previously mentioned, certain expenditures were eliminated from the mining costs because of their capital nature and also the increase in the reserves. The elimination of these items in respect of mining costs would reduce the above figures for the years 1939 and 1944 by 15 cents and 12 cents per ton, respectively.

The depreciation shown in the above tabulation is on the basis of 20 cents per long ton for the years 1930, 1935, and 1939, and for the year 1944 the rental paid to the Scotia Company.

Royalties

Included in the mining costs are the following amounts for royalties in the respective periods, based on 12½ cents per long ton:

1930–1935	$ 328,533.14
1936–1939	293,034.63
1940–1944	426,434.26
	$ 1,048,002.03

Production

The production, in tons per man day, for representative years is as follows:

—	1930	1935	1939	1944
	Tons	Tons	Tons	Tons
Surface Labour	10.40	12.62	13.38	10.81
Underground Labour	4.45	4.51	4.79	4.48
Mining Labour	4.46	5.06	5.06	5.52
Total Labour	1.83	2.00	2.08	2.02
	Per cent	Per cent	Per cent	Per cent
Percentage of Labour Cost to Total Cost	60	54	60	61

The production figures for this Company during the whole period from 1930 to 1944 are as hereunder:

	Tons
Total from 1930 to 1935	3,210,982
Yearly average	535,164
Total from 1936 to 1939	2,684,264
Yearly average	671,067
Total from 1940 to 1944	3,564,787
Yearly average	712,958
Grand total	9,460,033
Yearly average	630,669
Year of highest production—1942	749,337
Year of lowest production—1932	441,023
Total sales realization (1930–1944)	$49,948,137

SUMMARY

OLD SYDNEY COLLIERIES LIMITED, SYDNEY MINES, N.S.

Incorporated 1938

Capital	
Authorized—Common	$ 400,000
Issued—Common	$ 400,000
Consideration for issue of Capital—Cash	$ 400,000

	1944
Properties—Net Valuation	Leased
Net Current Position	$ 1,403,810
Surplus	263,326

Earnings Record

Losses—15 years	
(a) Before Income Tax	$ *2,499,777*
(b) After Income Tax	*2,593,618*

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ *414,039*	$ 17,078	$ 16,646	$ 15,974
(b) After Income Tax	*414,039*	17,078	16,646	10,174

Dividend Record

Total Dividends Paid—15 years	Nil

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 1,052,704
Total Depletion (15 years) charged to Operations	Nil

Assistance—Emergency Coal Production Board

Included in Accounts to 1944	
(a) Production Subsidies	Nil
Total Paid to March 31, 1946	
(a) Production Subsidies	Nil

Production Record

Total Tonnage—15 years	9,460,033 tons

Production Record—*Concluded*	1930	1935	1939	1944
Annual Production.........(tons)	567,132	609,849	681,508	682,850
Per Man-day Production....(tons)	1.83	2.00	2.08	2.02
Sales Realization—per ton........	$ 4.16	$ 3.55	$ 3.85	$ 6.00
Total Cost—per ton.............	4.59	4.00	3.81	5.70

REMARKS.—The production, sales and costs for the period prior to August 1, 1938, represent the figures for the coal department of Nova Scotia Steel Company, of which Old Sydney Collieries Limited is the continuation.

Other Coal Companies Operating on Cape Breton Island, Nova Scotia

(excluding Inverness Collieries)

Names of Companies	Production
Bras d'Or Coal Company Limited, Bras d'Or, Nova Scotia (15 years)........................	1,918,442 tons
Indian Cove Coal Company Limited, Sydney Mines, Nova Scotia (15 years)........................	690,426 tons
Sullivan Coal Company Limited, Sydney Mines, Nova Scotia (4 years)........................	60,431 tons
	2,669,299 tons

The three companies in this group operate on Cape Breton Island in the Province of Nova Scotia, and have produced approximately one per cent of the total Canadian tonnage over the fifteen-year period under review.

A comparative statement of their financial position in 1930 and 1944 follows:

—	1930	1944
	$	$
Assets—		
Properties..........	792,234.26	803,580.09
Less depreciation and depletion reserve..........	44,528.72	144,398.34
Net properties..........	747,705.54	659,181.75
Deferred..........	5,962.50	5,678.66
Net current position..........	175,655.31	188,784.62
	929,323.35	853,645.03
Liabilities—		
Capital..........	857,700.00	861,700.00
Surplus or *deficit*..........	71,623.35	*8,054.97*
	929,323.35	853,645.03

Subsidies of $68,521.97 have been received by these companies for the years 1943 and 1944. To March 31, 1946, additional production subsidies have been received in the amount $142,048.40, and at March 31, 1946, a loan of $9,967.32 was outstanding.

Dividends have been paid over the period of $167,212, which represent 1.3 per cent on the share capital.

Operating Results

The summarized statement of operations on the facing page shows that these companies realized an average of $3.70 per ton. Costs, including full depletion allowance of 10 cents per ton, amounted to $3.77, or an operating loss of 7 cents per ton. After subsidies and sundry revenues of 6 cents, this loss is reduced to one cent. After provision for income tax, the over-all loss is 2 cents per ton, which is accounted for by the losses in non-profitable years being greater than profits in profitable years.

The results for the 1930-1935 period show a loss of 5.9 cents per ton, for the standard period (1936-1939) a profit of 1.7 cents, and for the war years a loss of 2.2 cents per ton.

Using the 1936-1939 period as a base of 100, the following is a comparison of the indices for sales and costs for the other two periods:

Period	Sales	Costs
1930 – 1935	105.0	123.0
1936 – 1939	100.0	100.0
1940 – 1944	108.3	126.6

Mining costs per ton for representative years are as follows:

—	1930	1935	1939	1944
	$	$	$	$
Bras d'Or	3.49	3.34	3.53	5.34
Indian Cove	3.43	2.92	2.83	4.62
Sullivan	....	....	....	5.43

Production Per Man Day

—	1939	1944
	Tons	Tons
Bras d'Or	2.48	1.69
Indian Cove	2.40	1.80
Sullivan	....	2.00

OTHER COAL COMPANIES OPERATING ON CAPE BRETON ISLAND, NOVA SCOTIA

SUMMARY OF OPERATING RESULTS—1930 TO 1944

—	1930 to 1935			1936 to 1939			1940 to 1944			Totals		
	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton
Tonnage Sold	....	Tons 816,678	....	....	Tons 739,165	....	....	Tons 1,113,456	....	....	Tons 2,669,299	....
Realization	....	$ 2,854,536.10	$ 3.495	....	$ 2,458,944.92	$ 3.327	....	$ 4,556,844.90	$ 4.093	....	$ 9,870,325.92	$ 3.698
Deduct Costs												
Labour	42.772	1,240,977.03	1.520	63.646	1.539,077.60	2.082	64.377	2,982,661.64	2.679	57.901	5,762,716.27	2.159
Material	12.731	369,357.32	0.452	14.558	352,040.94	0.476	14.504	672,000.03	0.604	14.000	1,393,398.29	0.522
Power	4.862	141,077.60	0.173	4.297	103,918.46	0.141	3.152	146,058.40	0.131	3.929	391,054.46	0.147
Taxes and Rentals	....	....	....	1.148	27,755.75	0.038	0.730	33,839.42	0.030	0.619	61,595.17	0.023
Royalties	4.073	118,163.25	0.145	5.156	124,681.42	0.169	4.256	197,199.53	0.177	4.421	440,044.20	0.165
Workmen's Compensation Board	1.889	54,803.35	0.067	2.754	66,587.51	0.090	3.329	154,252.65	0.139	2.770	275,643.51	0.103
Other Mining Costs	29.792	864,369.01	1.058	....	....	....	0.050	2,332.87	0.002	8.708	866,701.88	0.325
Administration and Overhead	2.109	61,187.47	0.075	6.203	150,008.77	0.203	6.563	304,095.01	0.273	5.177	515,291.25	0.193
	98.228	2,849,935.03	3.490	97.762	2,364,070.45	3.199	96.991	4,492,439.55	4.035	97.525	9,706,445.03	3.637
Depreciation	....	....	....	0.420	10,149.00	0.014	1.430	66,260.33	0.060	0.768	76,409.33	0.029
Depletion	1.772	51,413.20	0.063	1.818	43.960.90	0.059	1.609	74,511.30	0.066	1.707	169,885.40	0.063
Total Cost	100.000	2,901,348.23	3.553	100.000	2,418,180.35	3.272	100.000	4,633,211.18	4.161	100.000	9,952,739.76	3.729
Operating Profit or *Loss*	....	*46,812.13*	*0.058*	....	40,764.57	0.055	....	*76,366.28*	*0.068*	....	*82,413.84*	*0.031*
Add Sundry Revenue	....	31,269.27	0.038	....	9,168.05	0.012	....	47,256.09	0.042	....	87,693.41	0.033
Subsidies	....	....	....	....	....	....	....	68,521.97	0.062	....	68,521.97	0.026
Profit or *Loss*, before Income Tax	....	*15,542.86*	*0.020*	....	49,932.62	0.067	....	39,411.78	0.036	....	73,801.53	0.028
Deduct Income Taxes	....	2,145.35	0.002	....	7,013.52	0.009	....	25,542.47	0.023	....	34,701.34	0.013
Net Profit or *Loss*	....	*17,688.21*	*0.022*	....	42,919.10	0.058	....	13,869.31	0.013	....	39,100.19	0.015
Depletion is not set up in the books of all Companies; if entered at 10 cents per ton, a further charge would be necessary, of	....	30,254.60	0.037	....	29,955.60	0.041	....	36,834.30	0.034	....	97,044.50	0.037
Making a net Profit or *Loss* of	....	*47,942.81*	*0.059*	....	12,963.50	0.017	....	*22,964.99*	*0.021*	....	*57,944.31*	*0.022*

NOTE:—In the 1930–35 period, the accounts of one Company are not capable of segregation into the Cost Headings as shown, and the total costs are included in "Other Mining Costs".

SUMMARY

BRAS D'OR COAL COMPANY LIMITED, BRAS D'OR, N.S.

Incorporated 1917

Capital		
Issued—Common	$ 182,900	
Preferred	599,800	
Consideration for issue of Capital—Properties	$ 782,700	
	1930	**1944**
Properties—Net Valuation	$ 699,905	$ 632,447
Net Current Position	72,967	106,972
Deficit	*4,116*	*38,218*

Earnings Record

Losses—15 years	
(a) Before Income Tax	$ *53,489*
(b) After Income Tax	*69,489*

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ 5,165	$ *2,245*	$ *3,992*	$ *55,438**
(b) After Income Tax	5,165	*2,245*	*3,992*	*55,438**

Dividend Record

Total Dividends Paid—15 years	$35,992 on preferred shares.
Rate on Capital	0.4 per cent

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 54,891
Total Depletion (15 years) charged to Operations	169,885

Assistance—Emergency Coal Production Board

Included in Accounts to 1944 — Production Subsidies	$ 47,473*
Total Paid to March 31, 1946 — Production Subsidies	$ 130,660

Production Record

Total Tonnage—15 years .... 1,918,442 tons

	1930	1935	1939	1944
Annual Production—tons	122,024	104,936	124,834	147,163
Per Man-day Production—tons	—	—	2.48	1.69
Sales Realization—per ton	$ 3.52	$ 3.30	$ 3.48	$ 4.90
Total Cost—per ton	3.49	3.34	3.53	5.34

REMARKS.—* Loss for 1944 is before the subsidy claimed of $47,473.

SUMMARY

INDIAN COVE COAL COMPANY LIMITED, SYDNEY MINES, N.S.

Capital				
Authorized—Common—A			$ 15,000	
Common—B			60,000	
Issued—Common—A			$ 15,000	
Common—B			60,000	
Consideration for issue of Capital				
Cash			$ 15,000	
Properties			60,000	
			1930	1944
Properties—Net Valuation			$ 47,800	$ 22,470
Net Current Position			102,688	34,132
Surplus or *Deficit*			75,740	*17,876*
Earnings Record				
Profits—15 years				
(a) Before Income Tax			$ 76,991	
(b) After Income Tax			59,397	
Annual Profit	1930	1935	1939	1944
(a) Before Income Tax	$ 16,042	$ 901	$ 16,603	$ 3,319
(b) After Income Tax	15,347	766	13,903	653
Dividend Record				
Total Dividends Paid—15 years			$ 130,500	
Rate on Capital			12 per cent	
Depreciation and Depletion				
Total Depreciation (15 years)				
Charged to Operations			$ 22,344	(1935-1944)
Total Depletion (15 years)				
Charged to Operations			Nil	
Assistance—Emergency Coal Production Board				
Included in Accounts to 1944				
Production Subsidies			$ 12,482	
Total Paid to March 31, 1946				
(a) Production Subsidies			$ 54,817	
(b) Non-Interest Bearing Loan			9,967	
Production Record				
Total Tonnage—15 years			690,426 tons	
	1930	1935	1939	1944
Annual Production—tons	51,162	48,700	63,386	36,498
Per Man-day Production—tons	—	—	2.40	1.80
Sales Realization—per ton	$ 3.90	$ 3.20	$ 3.23	$ 4.37
Total Cost—per ton	3.43	2.92	2.83	4.62

SUMMARY

SULLIVAN COAL COMPANY LIMITED, SYDNEY MINES, N.S.

Incorporated 1941

Capital	
Authorized—Common	$ 4,000
Issued—Common	$ 4,000
Consideration for issue of Capital—Cash	$ 4,000
	1944
Properties—Net Valuation	$ 4,264
Net Current Positon	206
Surplus	565
Earnings Record	
Profits—5 years	
(a) Before Income Tax	$ 2,827
(b) After Income Tax	1,720
Annual Profit or *Loss*	1944
(a) Before Income Tax	$ *389*
(b) After Income Tax	*389*
Dividend Record	
Total Dividends Paid—5 years	$ 720
Rate on Capital	6 per cent for 3 years
Depreciation and Depletion	
Total Depreciation (5 years) Charged to Operations	$ 1,944
Total Depletion (5 years) Charged to Operations	Nil
Assistance—Emergency Coal Production Board	
Included in Accounts to 1944	
Production Subsidies	$ 8,566
Total Paid to March 31, 1946	
Production Subsidies	$ 25,094
Production Record	
Total Tonnage—5 years	60,431 tons
	1944
Annual Production—tons	11,535
Per Man-day Production—tons	2
Sales Realization—per ton	$ 4.67
Total Cost—per ton	5.43

Other Coal Companies Operating on Mainland Province of Nova Scotia

	Production
Greenwood Coal Company Limited, New Glasgow, N.S. (15 years)	642,536 tons
Hillcrest Mining Company Limited, River Hebert, N.S. (3 years)	254,259 tons
Intercolonial Coal Company Limited, Westville, N.S. (15 years)	2,659,838 tons
Joggins Coal Company Limited, Amherst, N.S. ($5\frac{1}{3}$ years)	635,915 tons
Standard Coal Company Limited, Amherst, N.S. (5 years)	325,983 tons
	4,518,531 tons

The above companies produce approximately 2 per cent of Canadian coal, and it will be observed that of the total the Intercolonial Company produces more than half for this group.

Of these companies, Intercolonial is in a strong financial position, having net current assets of $785,000; Greenwood and Joggins are in a fair state with net current assets of $78,000; and the remaining two have an excess of immediate liabilities over quick assets of $132,000.

A summary of the state of affairs of this group as at 1930 and 1944 is shown hereunder:

NOVA SCOTIA

—	1930	1944
	$	$
Assets—		
Properties	1,102,761.45	935,632.44
Less depreciation and depletion reserve	149,047.73	298,029.31
Net Properties	953,713.72	637,603.13
Goodwill (Intercolonial)	500,000.00	500,000.00
Deferred	7,111.49	24,560.20
Net current position	582,741.38	731,826.76
	2,043,566.59	1,893,990.09
Liabilities—		
Capital	1,240,300.00	1,442,300.00
Reserves	251,516.96	184,603.59
Surplus	551,749.63	267,086.50
	2,043,566.59	1,893,990.09

During the period under review Intercolonial paid annual dividends on its preferred stock at 8 per cent which totalled $242,112 and dividends of $650,000 on the common capital stock of $1,000,000, or at an average rate of 4.33 per cent in varying amounts ranging from 1 to 8 per cent. The assets of this Company include a good will figure of $500,000. The Joggins Company paid dividends at the rate of from 8 to 30 per cent for an average of 15 per cent per annum on the capital outstanding totalling $87,500; the remaining companies did not pay any dividends.

Operating Results

On the facing page is a statement showing the operating results of these five companies which, after including depletion at 10 cents per ton, result in average earnings after subsidies, sundry revenue and income taxes of $15\frac{1}{2}$ cents per ton.

However, in this group there are two profitable companies (Intercolonial and Joggins), and the other three have sustained losses over the period under review. In the Intercolonial Company investment income totals $357,000 and is included in the final net profit.

The total net profit is further segregated:

Profitable companies (2)—Net earnings	$ 751,971.34
Less: Unprofitable companies (3)—Net losses	60,400.23
Net earnings of all companies in group	$ 691,571.11

The per-ton profits after income taxes and depletion at 10 cents per ton amount to (for the profitable companies) an average of 24.8 cents per ton for Intercolonial and 14.7 cents per ton for Joggins. The unprofitable companies lost 1 cent, 13.2 cents and 8.2 cents per ton over the period.

Per Man-day Production

For the year 1944, the man-day production was as follows:

	Tons
Intercolonial	1.67
Joggins	2.60
Greenwood	1.14
Hillcrest	2.06
Standard	2.08

Government Assistance

Finalized to the end of 1944, production subsidies have been received as follows:

Greenwood	$ 83,788.41
Intercolonial	75,068.56
Hillcrest	31,511.29
Standard	28,552.69
	$ 218,920.95

Additional subsidies to March 31, 1946, have been received by the above companies amounting to $144,741.87, while three other mines not covered by the survey received total production subsidies to March 31, 1946, of $20,972.19, or a total of government assistance of $384,635.01.

OTHER COAL COMPANIES—MAINLAND—PROVINCE OF NOVA SCOTIA

SUMMARY OF OPERATIONS—1930 TO 1944

—	1930 to 1935			1936 to 1939			1940 to 1944			Totals		
	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton
		Tons			Tons			Tons			Tons	
Tonnage Sold	....	1,117,349	....	....	1,013,220	....	....	2,370,642	....	....	4,501,211	....
		$	$		$	$		$	$		$	$
Realization	....	4,757,387.62	4.258		3,936,050.02	3.885		9,854,603.16	4.157		18,548,080	4.121
Deduct Costs												
Labour	61.451	2,847,407.61	2.548	60.887	2,298,516.94	2.269	49.055	4,814,325.87	2.031	54.658	9,960,250.42	2.212
Material	9.397	435,431.36	0.390	9.375	353,896.31	0.349	8.503	834,493.78	0.352	8.912	1,623,821.45	0.361
Power	5.641	261,359.30	0.234	5.379	203,074.40	0.200	4.220	414,174.94	0.175	4.821	878,608.64	0.195
Taxes and Rentals	2.418	112,041.68	0.100	2.014	76,017.22	0.075	1.050	103,039.33	0.043	1.597	291,098.23	0.065
Royalties	2.966	137,420.62	0.123	3.459	130,572.29	0.129	3.996	392,219.47	0.165	3.623	660,212.38	0.147
Workmen's Compensation Board	2.046	94,795.23	0.085	3.022	114,072.31	0.113	2.369	232,511.38	0.098	2.422	441,378.92	0.098
Other Mining Costs	4.136	191,655.54	0.172	4.870	183,862.80	0.181	22.258	2,184,424.21	0.921	14.048	2,559,942.55	0.569
Administration and Overhead	7.303	338,387.58	0.303	5.827	219,956.01	0.217	4.655	456,817.14	0.193	5.571	1,015,160.73	0.226
	95.358	4,418,498.92	3.955	94.833	3,579,968.28	2.533	96.106	9,432,006.12	3.978	95.652	17,430,473.32	3.873
Depreciation	2.488	115,282.63	0.103	2.775	104,774.30	0.103	1.933	189,749.36	0.080	2.249	409,806.29	0.090
Depletion	2.154	99,815.30	0.089	2.392	90,297.50	0.090	1.961	192,464.97	0.082	2.099	382,577.77	0.085
Total Cost	100.000	4,633,596.85	4.147	100.000	3,775,040.08	3.726	100.000	9,814,220.45	4.140	100.000	18,222,857.38	4.048
Operating Profit	....	123,790.77	0.111	....	161,009.94	0.159	....	40,382.71	0.017	....	325,183.42	0.073
Add Sundry Revenue	....	168,769.78	0.151	....	120,278.06	0.119	....	206,949.66	0.087	....	495,997.50	0.110
Subsidies	....	....	....	....	....	....	....	218,920.95	0.092	....	218,920.95	0.049
Profit, before Income Taxes	....	292,560.55	0.262	....	281,288.00	0.278	....	466,253.32	0.196	....	1,040,101.87	0.232
Income Taxes	....	29,375.40	0.026	....	47,084.76	0.046	....	204,527.27	0.086	....	280,987.43	0.062
Net Profit	....	263,185.15	0.236	....	234,203.24	0.232	....	261,726.05	0.110	....	759,114.44	0.170
Depletion is not set up in the books of all Companies. If entered at 10 cents per ton, a further charge would be necessary, of	....	11,919.60	0.011	....	11,024.50	0.010	....	44,599.23	0.018	....	67,543.33	0.015
Making a Net Profit of	....	251,265.55	0.225	....	223,178.74	0.222	....	217,126.82	0.092	....	691,571.11	0.155

NOTE.—In 1940-1944 period, there is one Company whose accounts are not capable of placing on same comparable basis as the others, and therefore, the total costs are shown under "Other Mining Costs".

SUMMARY

GREENWOOD COAL COMPANY LIMITED, NEW GLASGOW, N.S.

Incorporated 1916

Capital		
Authorized—Common	$ 30,000	
Issued—Common	$ 30,000	
Consideration for issue of Capital—Cash	$ 30,000	
	1930	1944
Properties—Net Valuation	$ 196,672	$ 52,325
Net Current Position	26,827	19,997*
Surplus	127,768	82,592*

Earnings Record

Losses—15 years	
(a) Before Income Tax	$ *9,150*
(b) After Income Tax	*12,802*

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ 416	$ *1,631*	$ *4,927*	$*10,455**
(b) After Income Tax	416	*1,631*	*4,927*	*10,455**

Dividend Record

Total Dividends Paid—15 years	Nil

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 38,435
Total Depletion (15 years) charged to Operations	57,359

Assistance—Emergency Coal Production Board

Included in Accounts to 1944	
(a) Production Subsidies	$ 70,770
(b) Production Subsidies Receivable	13,018
Total Paid to March 31, 1946	
(a) Production Subsidies	$ 101,728

Production Record

Total Tonnage—15 years	642,536 tons

	1930	1935	1939	1944
Annual Production (tons)	25,808	52,530	40,155	31,206
Per Man-day Production (tons)	—	—	1.52	1.14
Sales Realization—per ton	$ 4.46	$ 4.23	$ 4.07	$ 6.15
Total Cost—per ton	4.54	4.32	4.23	8.20

REMARKS.—Subsidy receivable of $13,018 is included in figures marked (*).

SUMMARY

HILLCREST MINING COMPANY LIMITED, RIVER HEBERT, N.S.

Incorporated 1940

Capital		
Authorized—Common	$ 120,000	
Issued—Common	$ 120,000	
		1944
Properties—Net Valuation		$ 170,839
Net Current Position		*76,932*
Deficit		*10,452*
Earnings Record		
Losses—4 years		
(a) Before Income Tax	$ *6,551*	
(b) After Income Tax	*8,081*	
Annual *Loss*		1944
(a) Before Income Tax		$ *14,110*
(b) After Income Tax		*14,110*
Dividend Record		
Total Dividends Paid—4 years	Nil	
Depreciation and Depletion		
Total Depreciation (4 years) charged to Operations	$ 43,197	
Total Depletion (4 years) charged to Operations	5,685	
Assistance—Emergency Coal Production Board		
Included in Accounts to 1944		
Production Subsidies	$ 31,511	
Total Paid to March 31, 1946—		
Production Subsidies	$ 55,572	
Production Record		
Total Tonnage—4 years	254,259 tons	
		1944
Annual Production (tons)		88,218
Per Man-day Production (tons)		2.06
Sales Realization—per ton		$ 3.67
Total Cost—per ton		4.20

SUMMARY

INTERCOLONIAL COAL COMPANY LIMITED, WESTVILLE, N.S.

Incorporated 1923

Capital

Issued—Common	$1,000,000
Preferred	217,900

Consideration for issue of Capital

Cash	$ 717,900
Goodwill	500,000

	1930	1944
Properties—Net Valuation	$ 757,041	$ 336,762
Net Current Position	555,914	785,397
Surplus	423,981	246,030

Earnings Record

Profits—15 years

(a) Before Income Tax	$ 903,292
(b) After Income Tax	699,340

Annual Profit	1930	1935	1939	1944
(a) Before Income Tax	$ 40,002	$ 44,269	$ 61,655	$ 35,486
(b) After Income Tax	37,224	38,292	52,239	21,292

Dividend Record

Total Dividends Paid—15 years

Common.....$650,000 4.3 per cent varying at rates from 1 per cent to 8 per cent.

Preferred.....$242,112, being at the rate of 8 per cent.

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 277,141
Total Depletion (15 years) charged to Operations	237,370

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

Production Subsidies	$ 86,050

Total Paid to March 31, 1946

Production Subsidies	$ 148,730

Production Record

Total Tonnage—15 years	2,659,838 tons

	1930	1935	1939	1944
Annual Production (tons)	166,808	143,277	192,670	160,871
Per Man-Day Production (tons)	1.48	1.64	1.76	1.67
Sales Realization—per ton	$ 4.50	$ 4.00	$ 3.84	$ 5.66
Total Cost—per ton	$ 4.42	$ 3.89	$ 3.73	$ 6.12

SUMMARY

JOGGINS COAL COMPANY LIMITED, AMHERST, N.S.

Incorporated 1939

Capital		
Authorized—Common	$ 125,000	
Issued—Common	$ 125,000	
Consideration for issue of		
Capital—Cash	$ 50,300	
Properties	74,700	
		1944
Properties—Net Valuation		$ 69,590
Net Current Position		71,390
Surplus		13,836
Earnings Record		
Profits—5 years		
(a) Before Income Tax	$ 176,450	
(b) After Income Tax	101,336	
Annual Profit or *Loss*	1939	1944
(a) Before Income Tax	$ 9,743	$ 19,866
(b) After Income Tax	8,261	11,919
Dividend Record		
Total Dividends Paid—5 years	$ 87,500	
Rate on Capital—for 4 years at 30 per cent, 16 per cent, 16 per cent, and 8 per cent.		
Depreciation and Depletion		
Total Depreciation (5 years) charged to Operations	$ 38,412	
Total Depletion (5 years) charged to Operations	53,521	
Assistance—Emergency Coal Production Board		
Included in Accounts to 1944		
Production Subsidies	Nil	
Total Paid to March 31, 1946		
Production Subsidies	Nil	
Production Record		
Total Tonnage—5 years	635,915 tons	
	1939	1944
Annual Production (tons)	30,861	119,787
Per Man-Day Production (tons)		2.6
Sales Realization—per ton	$ 3.14	$ 4.36
Total Cost—per ton	2.83	4.23

SUMMARY

STANDARD COAL COMPANY LIMITED, AMHERST, N.S.

Incorporated 1939

Capital		
Issued—Common	$ 10,000	
Consideration for issue of Capital—Cash	$ 10,000	
		1944
Properties—Net Valuation		$ 7,815
Net Current Position		*55,007*
Deficit		*51,901*
Earnings Record		
Losses—5 years.		
(a) Before Income Tax	$ *37,272*	
(b) After Income Tax	*37,272*	
Annual Profit or Loss		1944
(a) Before Income Tax		$ *3,122*
(b) After Income Tax		*3,122*
Dividend Record		
Total Dividends Paid—5 years	Nil	
Depreciation and Depletion		
Total Depreciation (5 years) charged to Operations	$ 12,620	
Total Depletion (5 years) charged to Operations	28,643	
Assistance—Emergency Coal Production Board		
Included in Accounts to 1944 Production Subsidies	$ 14,165	
Total Paid to March 31, 1946 Production Subsidies	$ 57,633	
Production Record		
Total Tonnage—5 years	325,983 tons	
		1944
Annual Production (tons)		72,499
Per Man-Day Production (tons)		2.08
Sales Realization—per ton		$ 4.08
Total Cost—per ton		$ 4.25

Inverness Collieries, Cape Breton

The survey for this operation covered the years 1940 to 1945, inclusive. Production and losses sustained over the period are:

—	Production	Loss	Per ton
	tons	$	$
1940	139,770	38,741.62	0.277
1941	124,864	94,303.95	0.754
1942	103,673	107,172.17	1.034
1943	85,136	101,450.34	1.192
1944	84,702	241,135.33	2.847
1945	72,065	296,220.00	4.110
	610,210	879,023.41	1.441

These mines were operated for the years 1902 to 1915 and 1920 to 1921 by the Inverness Railway and Coal Company, by receivers from 1916 to 1919 and from 1922 to 1931. In the year 1924 the Province of Nova Scotia guaranteed the operations and this was in effect until 1934, when the mine was placed under government control more or less as an employment measure.

During the period of government guarantee and control the Province of Nova Scotia paid in operating losses, from 1927 to 1939, the sum of $1,050,411.09, and on account of capital $358,037.35.

The total production from the Inverness field amounts to:

From 1901 to 1929		5,421,179 tons
From 1930 to 1939	1,114,358 tons	
From 1940 to 1945	610,210 tons	
		1,754,568 tons
		7,175,747 tons

During the period of government control or guarantee the mine produced 2,428,644 tons, for a total cost to the Government on operation of $1,929,434.50 or 79.4 cents per ton. Capital expenditures during the whole period amounted to $405,464.31, which would increase the loss by 16.7 cents for a total cost of 96 cents per ton.

Subsidy assistance by the Dominion Government finalized to November 30, 1945, amounted to $110,411.70.

In the loss sustained over the period 1940-1945 of $879,023.41 the following classes of expenditures are included:

Interest on losses and on capital to the Province	$ 103,008.41
Royalties at rate of 12½ cents per ton on certain production to Province	61,895.34
Workmen's Compensation Board	114,612.98
Taxes—property	59,436.18
	$ 338,952.91

The average sales realization varies from $3.58 per ton in 1940 to $5.07 per ton in 1945.

Of the total average cost of $5.87 per ton, labour represents $3.21 or 55 per cent.

The mines worked an average of 290 days per annum and employed over the period an annual average of 291 employees. The man-day production in 1944 and 1945 was 1.2 and 1.1 tons.

The total sales of 612,154 tons during the years 1940 to 1945 are to the following consumers:

	Tons
Canadian National Railways	65,827
S. Cunard Company	122,806
Commercial and local sales, Nova Scotia	212,627
Commercial—New Brunswick	17,037
Prince Edward Island	28,716
Quebec	793
Government institutions	10,489
Employees and boiler coal for power	153,859
Total	612,154

COMPANIES OPERATING IN PROVINCE OF NEW BRUNSWICK

	Production
Avon Coal Company Limited, Saint John, N.B.	713,136 tons
W. B. Evans, Minto, N.B.	481,620 tons
King Coal Mines, Chipman, N.B. (13 years)	239,075 tons
Miramichi Lumber Company Limited, Minto, N.B.	898,150 tons
Minto Coal Company Limited, Minto, N.B.	1,365,168 tons
Newcastle Coal Company, Minto, N.B. (6 years)	140,207 tons
Welton and Henderson Limited, Minto, N.B.	559,847 tons
	4,397,203 tons

The comparative balance sheet as at the end of the fiscal periods of the above operators in 1930 (five) and 1944 (seven) is shown hereunder.

Three of the operations are proprietorships, three are limited companies and one is a department of a lumber company.

The 1944 financial position shows properties having a depreciated value of $500,000 and the net current position $338,000. Of these operators, there are three which have a deficiency or an excess of current liabilities over current assets totalling approximately $48,000; the other four have a net current position of $386,000.

—	1930	1944
	$	$
Assets—		
Properties	1,151,799.30	1,315,645.05
Less depreciation and depletion reserve	509,692.28	814,053.50
Net properties	642,107.02	501,591.55
Deferred	66,993.15	67,698.05
Net current position	218,341.94	338,000.13
	927,442.11	907,289.73
Liabilities—	1930	1944
Capital—Share	601,000.00	601,200.00
Proprietors' Equity	171,764.20	212,865.71
Funded Debt	109,000.00	33,000.00
Reserves	46,920.12	59,510.29
Surplus or *Deficit*	*1,242.21*	713.73
	927,442.11	907,289.73

PRODUCING COAL COMPANIES IN THE PROVINCE OF NEW BRUNSWICK
SUMMARY OF OPERATING RESULTS—1930 TO 1944

—	1930 to 1935			1936 to 1939			1940 to 1944			Totals		
	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton
		Tons			Tons			Tons			Tons	
Tons Sold	....	1,388,510	....	....	1,256,843	....	....	1,898,303	....	....	4,543,656	....
		$	$		$	$		$	$		$	$
Realization	....	5,073,661.57	3.654	....	4,348,873.28	3.460	....	8,281,470.16	4.363	....	17,704,005.01	3.896
Deduct Costs												
Purchased Coal	....	....	....	4.897	220,781.67	0.176	5.367	474,329.60	0.250	3.759	695,111.27	0.153
Labour	57.287	2,947,217.61	2.122	55.383	2,496,753.45	1.987	53.747	4,750,334.46	2.503	55.131	10,194,305.52	2.245
Material	8.040	413,640.02	0.298	8.530	384,567.53	0.306	6.088	538,109.32	0.283	7.227	1,336,316.87	0.294
Power	2.038	104,826.46	0.075	1.936	87,292.89	0.069	1.963	173,506.35	0.091	1.977	365,625.70	0.080
Taxes and Rentals	0.631	32,438.33	0.023	0.544	24,537.48	0.020	0.499	44,099.70	0.023	0.547	101,075.51	0.022
Royalties	3.167	162,937.23	0.117	3.223	145,295.19	0.116	1.870	165,251.09	0.087	2.561	473,483.51	0.104
Workmen's Compensation Board	3.549	182,596.39	0.132	3.764	169,669.06	0.135	2.606	230,366.58	0.122	3.151	582,632.03	0.128
Other Mining Costs	7.529	387,313.58	0.279	5.107	230,246.16	0.183	16.030	1,416,749.70	0.746	11.002	2,034,309.44	0.448
Administration and Overhead	11.627	598,174.84	0.431	10.168	458,411.95	0.365	7.473	660,469.94	0.348	9.286	1,717,056.73	0.378
	93.868	4,829,144.46	3.477	93.552	4,217,555.38	3.357	95.643	8,453,216.74	4.453	94.641	17,499,916.58	3.852
Depreciation	3.796	195,308.00	0.141	4.122	185,817.95	0.148	2.617	231,337.55	0.122	3.312	612,463.50	0.135
Depletion	2.336	120,172.88	0.087	2.326	104,802.68	0.082	1.740	153,755.38	0.081	2.047	378,730.94	0.083
Total Cost	100.000	5,144,625.34	3.705	100.000	4,508,176.01	3.587	100.000	8,838,309.67	4.656	100.000	18,491,111.02	4.070
Operating Profit or *Loss*	....	*70,963.77*	*0.051*	....	*159,302.73*	*0.127*	....	*556,839.51*	*0.293*	....	*787,106.01*	*0.174*
Add Sundry Revenue	....	156,609.10	0.113	....	83,458.69	0.066	....	256,100.14	0.135	....	496,167.93	0.110
Subsidies	....	....	....	....	....	....	....	389,135.59	0.205	....	389,135.59	0.086
Net Profit or *Loss*, before Income Taxes	....	85,645.33	0.062	....	*75,844.04*	*0.061*	....	88,396.22	0.047	....	98,197.51	0.022
Deduct Income Taxes	....	17,405.07	0.013	....	2,225.17	0.002	....	86,583.19	0.046	....	106,213.43	0.023
Net Profit or *Loss*	....	68,240.26	0.049	....	*78,069.21*	*0.063*	....	1,813.03	0.001	....	*8,015.92*	*0.001*
Depletion is not set up in the books of all Companies. If entered at 10 cents per ton, a further charge would be necessary, of	....	18,678.12	0.013	....	20,881.62	0.018	....	36,074.92	0.019	....	75,634.66	0.017
Making a Net Profit or *Loss*	....	49,562.14	0.036	....	*98,950.83*	*0.081*	....	*34,261.89*	*0.018*	....	*83,650.58*	*0.018*

During the period under review the Minto Coal Company Limited paid $218,000 in dividends, Welton and Henderson Limited paid dividends of $39,739, and the Newcastle Coal Company paid the sum of $25,902.65 as drawings to the proprietor.

Operating Results

On the previous page is a summary of the profit and loss accounts for the fifteen-year period, which shows these operators have sold 4,543,656 tons or approximately 2 per cent of the total Canadian tonnage. They realized an average of $3.90 per ton with costs of $4.09, including full depletion of 10 cents per ton. After sundry revenue and subsidies have been subtracted from the net loss of 19 cents, the result before income taxes is a profit of one-half cent per ton.

On the books of the operators the Minto and Welton and Henderson Companies show profits after income taxes of	$291,063.10
on a capital stock of $451,000.00, or at the rate of 4.3 per cent per annum.	
W. B. Evans and the Newcastle Coal Company show a total profit of	$ 6,314.89
on a capital of $75,150.00,	
And the three others show losses totalling	305,393.91
Which makes the over-all loss for the field of	8,015.92

The cost of mining as between operators, together with a comparison with the sales realization and production per man-day for representative years, is as follows:

PROFITABLE OPERATIONS (MINTO AND WELTON AND HENDERSON)

—	1930	1935	1939	1944
	$	$	$	$
Sales—Minto Coal Co. Ltd.	4.55	3.58	3.57	4.78
—Welton & Henderson Ltd.	4.30	3.35	3.52	5.63
Costs—Minto Coal Co. Ltd.	4.31	3.65	3.20	5.81
—Welton & Henderson Ltd.	4.04	3.40	3.67	6.15
	tons	tons	tons	tons
Production per man-day—Minto Coal Co.	....	1.17	1.46	1.38
—Welton & Henderson Ltd.	1.53	1.42	1.09	1.15

The above figures are before subsidies and sundry revenues.

SMALL PROFIT OPERATIONS (EVANS AND NEWCASTLE)

—	1930	1935	1939	1944
	$	$	$	$
Sales—W. B. Evans	4.23	3.36	3.48	6.39
—Newcastle Coal Co.	....	....	3.41	5.38
Costs—W. B. Evans	3.94	3.55	3.36	6.75
—Newcastle Coal Co.	....	....	3.31	6.86

NON-PROFITABLE OPERATIONS (THREE)

—	1930	1935	1939	1944
	$	$	$	$
Sales	3.65	3.23	3.61	5.50
	....	3.06	3.12	5.30
	4.29	3.44	3.56	5.43
Costs	3.36	3.38	3.70	7.46
	....	2.88	3.36	6.33
	4.11	3.61	3.74	6.35
	tons	tons	tons	tons
Production per man-day	2.00	1.42	1.39	1.70
	....	....	1.44	1.16
	....	1.29	1.25	1.35

Government Assistance

Production subsidies have been paid to companies in New Brunswick totalling $819,378.26 by the Emergency Coal Production Board to March 31, 1946. Of this total, the companies reviewed were paid $774,131.45 as follows:

Minto Coal Company Limited	$268,955.87
Avon Coal Company	145,760.67
W. B. Evans	105,167.08
Miramichi Lumber Company Limited	88,661.36
King Coal Mines	65,233.55
Newcastle Coal Company	56,545.45
Welton and Henderson Limited	43,807.47
	$774,131.45

The balance of the subsidies amounting to $45,246.81 was paid to eight small operators. In addition, a grant of $1,805.30 was made to a company not included in this survey.

Government loans amounting to $20,260.93 were outstanding from New Brunswick companies at March 31, 1946.

SUMMARY

AVON COAL COMPANY LIMITED, SAINT JOHN, N.B.

Capital		
Authorized—Common	$ 50,000	
Preferred	100,000	
Issued— Common	$ 50,000	
Preferred	100,000	
Consideration for issue of Capital—Cash / Properties	$ 150,000	
	1930	1944
Properties—Net Valuation	$ 177,290	$ 117,135
Net Current Position	48,752	9,953
Deficit	*31,516*	*54,392*
Earnings Record		
Losses—15 years		
(a) Before Income Tax	$ *19,314*	
(b) After Income Tax	*20,634*	

SUMMARY

AVON COAL COMPANY LIMITED, SAINT JOHN, N.B.—*Concluded*

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ 12,267	$ 260	$ *659*	$ *9,529*
(b) After Income Tax	11,445	225	*659*	*9,529*

Dividend Record
Total Dividends Paid—15 years .... Nil

Depreciation and Depletion
Total Depreciation (15 years) charged to Operations .... $ 251,367
Total Depletion (15 years) charged to Operations 97,787

Assistance—Emergency Coal Production Board
Included in Accounts to 1944
Production Subsidies .... $ 83,883

Total Paid to March 31, 1946
(a) Production Subsidies .... $ 145,761
(b) Loans 8,167

Production Record
Total Tonnage—15 years .... 713,136 tons

	1930	1935	1939	1944
Annual Production (tons)	40,538	52,360	47,113	47,801
Per Man-Day Production (tons)	1.99	1.41	1.39	1.69
Sales Realization—per ton	$ 3.65	$ 3.23	$ 3.61	$ 5.50
Total Cost—per ton	3.36	3.38	3.71	7.46
Total Cost—per ton—Stripping	—	—	—	5.84

SUMMARY

W. B. EVANS, MINTO, N.B.

PROPRIETORSHIP

	1930	1944
Properties—Net Valuation	$ 5,995	$ 17,504
Net Current Position	14,896	17,709
Proprietor's Capital	22,960	36,239

Earnings Record
Profits—15 years
Before Income Tax .... $ 1,050

Annual Profit or *Loss*	1930	1935	1939	1944
Before Income Tax	$ 5,564	$ *6,710*	$ 3,791	$ *10,760*

Depreciation and Depletion
Total Depreciation (15 years) charged to Operations .... $ 70,450
Total Depletion (15 years) charged to Operations 45,582

Assistance—Emergency Coal Production Board
Included in Accounts to 1944
(a) Production Subsidies .... $ 83,334
(b) Loans 18,569

Total Paid to March 31, 1946
(a) Production Subsidies .... $ 105,167
(b) Loans 11,354

SUMMARY

W. B. EVANS, MINTO, N.B.—*Concluded*

Production Record

Total Tonnage—15 years.................................... 481,620 tons

	1930	1935	1939	1944
Annual Production (tons)............	19,230	35,349	32,491	35,766
Per Man-Day Production (tons)......	—	1.05	1.36	1.18
Sales Realization—per ton...........	$ 4.03	$ 3.35	$ 3.43	$ 5.02
Total Cost—per ton.................	3.94	3.55	3.36	6.75

SUMMARY

KING COAL MINES, CHIPMAN, N.B.

Commenced 1933

PROPRIETORSHIP

	1933	1944
Properties—Net Valuation..	$ 23,195	$ 26,719
Net Current Position..	727	*26,634*
Proprietor's Capital...	23,922	85

Earnings Record

Losses—12 years—Before Income Tax..........................$ *27,081*

Annual Profit or *Loss*	1935	1939	1944
(a) Before Income Tax..........................	$ 2,998	$ *5,336*	$ *3,090*

Depreciation and Depletion

Total Depreciation (12 years) charged to Operations.............$ 21,825

Total Depletion (12 years) charged to Operations............... 27,375

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

Production Subsidies..................................$ 38,213

Total Paid to March 31, 1946

Production Subsidies..................................$ 65,234

Production Record

Total Tonnage—12 years.. 239,075 tons

	1935	1939	1944
Annual Production.... (tons)...................	16,423	22,546	22,287
Per Man-Day Production..... (tons)............	—	1.44	1.16
Sales Realization—per ton......................	$ 3.06	$ 3.12	$ 5.30
Total Cost—per ton..............................	2.88	3.36	6.53

SUMMARY

MIRAMICHI LUMBER COMPANY LIMITED, MINTO, N.B.

Coal Division of Lumber Company

	1930	1944
Properties—Net Valuation	$ 63,217	$ 117,446
Net Current Position	19,517	20,175
Capital Account	148,804	137,629

Earnings Record
Losses—15 years .... $ *156,667*

Annual Profit or *Loss*	1930	1935	1939	1944
Before Interest on Investment	$ *1,709*	$ *17,193*	$ *11,815*	$ *131*

Depreciation and Depletion
Total Depreciation (15 years) charged to Operations .... $ 33,027
Total Depletion (15 years) charged to Operations 75,675

Assistance—Emergency Coal Production Board
Included in Accounts to 1944
Production Subsidies .... $ 43,861

Total Paid to March 31, 1946
Production Subsidies .... $ 88,661

Production Record
Total Tonnage—15 years .... 898,150 tons

	1930	1935	1939	1944
Annual Production (tons)	27,379	68,666	73,962	40,389
Per Man-day Production (tons)	—	1.3	1.25	1.35
Sales Realization—per ton	$ 4.29	$ 3.44	$ 3.56	$ 5.43
Total Cost—per ton	4.11	3.61	3.74	6.33

SUMMARY

MINTO COAL COMPANY LIMITED, MINTO, N.B.

Capital
Issued—Common .... $ 400,000

Consideration for issue of
Capital—Cash }
Properties } .... $ 400,000

	1930	1944
Properties—Net Valuation	$ 375,667	$ 158,417
Net Current Position	55,350	227,278
Surplus	19,379	1,337

Earnings Record
Profits—15 years
(a) Before Income Tax .... $ 269,668
(b) After Income Tax 180,978

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ 12,736	$ *1,131*	$ 38,223	$ *7,649*
(b) After Income Tax	11,706	*1,131*	32,545	*7,649*

SUMMARY

MINTO COAL COMPANY LIMITED, MINTO, N.B.—*Concluded*

Dividend Record
Total Dividends Paid—15 years .... $ 218,000
Rate on Capital 3.6 per cent. Payments made in 11 years at rates varying from 2 per cent to 12½ per cent.

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 235,172
Total Depletion (15 years) charged to Operations	136,590

Assistance—Emergency Coal Production Board
Included in Accounts to 1944

Production Subsidies	$ 86,233

Total Paid to March 31, 1946

Production Subsidies	$ 268,956

Production Record
Total Tonnage—15 years .... 1,365,168 tons

	1930	1935	1939	1944
Annual Production (tons)	78,921	81,250	100,934	97,792
Per Man-day Production (tons)	—	1.18	1.46	1.38
Sales Realization—per ton	$ 4.55	$ 3.58	$ 3.59	$ 4.78
Total Cost—per ton	4.31	3.65	3.20	5 81

SUMMARY

NEWCASTLE COAL COMPANY, MINTO, N.B.

Commenced 1939

PROPRIETORSHIP

	1939	1944
Properties—Net Valuation	$ 73,160	$ 49,378
Net Current Position	*17,603*	*10,640*
Proprietor's Capital	55,558	38,912

Earnings Record

Losses—6 years	$ *4,013*	
	1939	1944
Annual Profit or *Loss*	$ 1,981	$ *4,655*
Proprietors' Drawings	$ 25,903	

Depreciation and Depletion

Total Depreciation (6 years) charged to Operations	$ 14,021
Total Depletion (6 years) charged to Operations	21,979

Assistance—Emergency Coal Production Board
Included in Accounts to 1944

Production Subsidies	$ 23,453

Total Paid to March 31, 1946

Production Subsidies	$ 56,545

Production Record
Total Tonnage—6 years .... 140,207 tons

	1939	1944
Annual Production (tons)	27,686	18,949
Sales Realization—per ton	$ 3.41	$ 5.38
Total Cost—per ton	3.34	6.86

SUMMARY

WELTON AND HENDERSON LIMITED, MINTO, N.B.

Capital

Issued—Common	$ 51,200
Consideration for issue of Capital—Cash	$ 51,200

	1930	1944
Properties—Net Valuation	$ 19,938	$ 14,994
Net Current Position	41,957	118,727
Surplus	10,895	53,769

Earnings Record

Profits—15 years

(a) Before Income Tax	$ 102,166
(b) After Income Tax	78,596

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ 8,757	$ 5,194	$ *1,737*	$ *8,118*
(b) After Income Tax	8,207	4,194	*1,737*	11,660

Dividend Record

Total Dividends Paid—15 years .... $ 39,739

Rate on Capital over all years is 5 per cent Payments made at 5 per cent one year, 6 per cent for two years, 8 per cent for three years and 30 per cent for one year.

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 8,506
Total Depletion (15 years) charged to Operations	19,416

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

(a) Production Subsidies	$ 22,498

Total Paid to March 31, 1946

(a) Production Subsidies	$ 43,807

Production Record

Total Tonnage—15 years .... 559,847 tons

	1930	1935	1939	1944
Annual Production (tons)	19,655	44,022	51,575	27,160
Per Man-day Production (tons)	1.53	1.42	1.09	1.15
Sales Realization—per ton	$ 4.30	$ 3.35	$ 3.52	$ 5.63
Total Cost—per ton	4.04	3.40	3.67	6.15

COMPANIES OPERATING IN SASKATCHEWAN

Names of Companies	Tons produced
Eastern Collieries of Bienfait Limited, Estevan (5 years)	324,309
Manitoba and Saskatchewan Coal Company, Limited, Bienfait and Taylorton (14 years)	3,138,359
The Roche Percée Coal Mining Company Limited, Roche Percée (5 years)	373,839
Western Dominion Coal Mines Limited, Taylorton (6 years)	3,879,119
	7,715,626

There are a large number of very small companies in Saskatchewan, and also a number which have operated over the period covered, which are now defunct or have reorganized or amalgamated with other companies and the records are not now available.

A comparison of the tonnage produced in Saskatchewan and those covered by the survey follows:

—	Total production (D. B. S.)	Companies covered in survey	Percentage
	tons	tons	Per cent
1930–1935	4,888,121	627,897	12.8
1936–1939	4,052,306	882,573	21.8
1940–1944	6,887,368*	6,205,156	90
	15,827,795	7,715,626	48.7

* Estimate.

As the figures are not available for the earlier years, a comparative summary of the financial position of these companies as at 1940 and 1944 is shown hereunder:

—	1940	1944
	$	$
Assets		
Properties, including coal lands	3,091,192.07	3,590,313.61
Less reserve for depreciation and depletion	689,463.50	1,984,690.61
	2,401,728.57	1,605,623.00
Deferred	14,936.93	34,082.29
Net current position, including investments	89,136.34	641,181.70
	2,505,801.84	2,280,886.99

—	1940	1944
	$	$
Liabilities		
Share capital	2,009,719.00	2,012,719.00
Funded debt and deferred liabilities	469,780.00	176,113.10
Surplus	26,302.84	92,054.89
	2,505,801.84	2,280,886.99

Manitoba and Saskatchewan Coal Company Limited and Western Dominion Coal Mines Limited have a fairly strong current position as at 1944, having some $726,000 in current assets; while the other two companies show an excess of current liabilities over assets of $85,000 and are consequently in a serious financial position.

Government Assistance

The following government assistance has been received by these companies:

Company	Production subsidy finalized to 1944	Additional production subsidy to March 31, 1946	Grants
	$	$	$
Manitoba and Saskatchewan	190,667.56	51,556.05	1,760.83
Roche Percée	21,050.98	....	....
Eastern Collieries	10,790.55	12,625.05	....
Western Dominion	....	....	74,128.97
	222,509.09	64,181.10	75,889.80

Other companies operating in Saskatchewan and not included in this survey received government assistance in the amount of $94,563.35. The total of all government subsidies and grants is $457,143.34, and in addition there were loans outstanding at March 31, 1946, amounting to $132,840.53.

On the facing page is a summary of the operating statements of these companies for the three periods under review. The Saskatchewan operations are mainly stripping. The tonnage from stripping was 7,023,786 and from deep seam 691,840 tons.

Both the mined and stripped coal has a very low realizable value, averaging $1.29 over the fifteen years. The average cost is $1.32, including full depletion of 10 cents per ton for an over-all loss of 3 cents per ton. After sundry revenue and subsidies are taken into account, the average profit is 1.4 cents per ton before income tax, and 0.2 cents per ton after income taxes are deducted.

The Eastern and Roche Percée Companies show a loss in every year, varying from 2 cents to 37 cents per ton. The Manitoba and Saskatchewan Company, while making profits in the war years, shows a total loss over the period of some $12,000, and the Western Dominion shows a profit earned in the war years of approximately $90,000.

PRODUCING COAL COMPANIES IN THE PROVINCE OF SASKATCHEWAN
SUMMARY OF OPERATING RESULTS—1930 TO 1944

—	1930 to 1935 (One Company)			1936 to 1939 (One Company)			1940 to 1944 (Four Companies)			Totals		
	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton
Tonnage Sold	....	Tons 612,173	....	....	Tons 800,183	....	....	Tons 6,077,163	....	....	Tons 7,489,519	....
Realization	....	$ 913,125.54	$ 1.492	....	$ 1,144,931.23	$ 1.431	....	$ 7,589,529.28	$ 1.247	....	$ 9,647,586.05	$ 1.286
Deduct Costs												
Labour	42.447	396,495.80	0.648	38.847	442,762.60	0.553	24.372	1,895,257.42	0.312	27.761	2,734,515.82	0.365
Material	9.327	87,123.38	0.142	13.180	150,222.70	0.188	9.858	766,557.13	0.126	10.192	1,003,903.21	0.134
Tipple and Railroad Costs	....	....	....	....	....	....	17.020	1,323,497.50	0.217	13.436	1,323,497.50	0.176
Underground Mine Expense	....	....	....	....	....	....	12.008	933,740.96	0.153	9.479	933,740.96	0.125
Power	5.607	52,375.72	0.086	6.617	75.421.07	0.094	4.062	315,897.41	0.053	4.504	443,694.20	0.059
Taxes and Rentals	1.611	15,052.55	0.025	0.863	9,838.04	0.012	0.266	20,675.98	0.003	0.463	45,566.57	0.006
Royalties	....	....	....	2.249	25,635.99	0.032	0.956	74,322.49	0.013	1.015	99,958.48	0.013
Workmen's Compensation Board	1.794	16,761.58	0.027	2.918	33,258.27	0.042	1.056	82,107.99	0.013	1.341	132,127.84	0.018
Other Mining Costs	7.708	71,998.79	0.118	5.320	60,632.75	0.076	2.535	197,098.34	0.032	3.347	329,729.88	0.044
Administration and Overhead	19.103	178,434.57	0.291	16.729	190,666.44	0.238	8.794	683,866.40	0.112	10.690	1,052,967.41	0.140
	87.597	818,242.39	1.337	86.723	988,437.86	1.235	80.927	6,293,021.62	1.034	82.228	8,099,701.87	1.080
Depreciation	8.167	76,290.86	0.125	5.534	63,069.65	0.079	11.437	889,345.93	0.146	10.444	1,028,706.44	0.137
Depletion	4.236	39,560.68	0.064	7.743	88,257.28	0.111	7.636	593,876.14	0.098	7.328	721,694.10	0.095
Total Cost	100.000	934,093.93	1.526	100.000	1,139,764.79	1.425	100.000	7,776,243.69	1.278	100.000	9,850,102.41	1.312
Operating Profit or *Loss*	....	*20,968.39*	*0.034*	....	5,166.44	0.006	....	*186,714.41*	*0.031*	....	*202,516.36*	*0.026*
Add Sundry Revenue	....	43,748.07	0.071	....	43,993.71	0.055	....	155,006.16	0.025	....	242,747.94	0.032
Subsidy	....	....	....	....	....	....	....	222,509.09	0.037	....	222,509.09	0.029
Profit	....	22,779.68	0.037	....	49,160.15	0.061	....	190,800.84	0.031	....	262,740.67	0.035
Deduct Bond Interest	....	60,450.00	0.099	....	36,940.00	0.046	....	30,340.00	0.005	....	127,730.00	0.017
Profit or *Loss* before Income Taxes	....	*37,670.32*	*0.062*	....	12,220.15	0.015	....	160,460.84	0.026	....	135,010.67	0.018
Deduct Income Taxes	....	654.74	0.001	....	9,629.98	0.012	....	80,649.45	0.013	....	90,934.17	0.012
Net Profit or *Loss*	....	*38,325.06*	*0.063*	....	2,590.17	0.003	....	79,811.39	0.013	....	44,076.50	0.006
Depletion is not set up in the books of all Companies. If entered at 10 cents per ton, a further charge would be necessary, of	....	21,656.62	0.036	....	*8,238.98*	*0.011*	....	14,840.16	0.002	....	28,257.80	0.004
Making a Net Profit or *Loss* of	....	*59,981.68*	*0.099*	....	10,829.15	0.014	....	64,971.23	0.011	....	15,818.70	0.002

A comparison of the production and cost per ton for the individual companies is as follows:

—	Man-day production	Cost per ton		Sales per ton	
	tons	$		$	
Manitoba and Saskatchewan Company—					
1931	4.69	1.58		1.66	
1932	5.83	1.50		1.46	
1933	5.79	1.55		1.48	
1934	6.40	1.54		1.46	
1935	6.41	1.41		1.42	
1936	6.62	1.32		1.55	
1937	5.75	1.60		1.47	
1938	5.35	1.45		1.39	
1939	6.19	1.34		1.31	
1940	6.96	1.48		1.28	
1941	8.15	1.26		1.28	
1942	8.13	1.22		1.24	
1943	7.05	1.56		1.55	
1944	9.09	1.84		1.40	
Eastern Collieries—					
1940	6.7	1.68		1.31	
1941	10.5	1.25		1.22	
1942	10.5	1.25		1.21	
1943	10.0	1.44		1.36	
1944	14.0	1.57		1.49	
Roche Percée—					
1940	...	1.20		1.09	
1941	...	1.16		1.14	
1942	...	1.17		1.13	
1943	...	1.25		1.22	
1944	13.0	1.55		1.29	
		Mined Coal		Stripping Coal	
		Cost per ton	Sales per ton	Cost per ton	Sales per ton
		$	$	$	$
Western Dominion—					
1940	...	1.20	1.09	0.66	1.09
1941	9.64	1.15	1.29	0.65	1.06
1942	10.62	2.09	1.37	0.61	1.09
1943	9.94	1.89	1.35	0.62	1.16
1944	11.87	1.59	1.49	0.65	1.26
1945	12.28	1.62	1.45	0.76	1.29

SUMMARY

EASTERN COLLIERIES OF BIENFAIT LIMITED, ESTEVAN, SASKATCHEWAN

Capital		
Issued—Common	$ 92,719	
Consideration for issue of Capital—Cash / Properties	$ 92,719	
		1944
Properties—Net Valuation:		$ 112,694
Net Current Position		*409*
Deficit		*29,407*
Earnings Record		
Profits or *Losses*—5 years	$ *13,562*	
	1940	1944
Annual Profit or *Loss*	$ *7,827*	$ 3,903
Dividend Record		
Total Dividends Paid—5 years	Nil	
Depreciation and Depletion		
Total Depreciation (5 years) charged to Operations	$ 38,954	
Total Depletion (5 years) charged to Operations	14,817	
Assistance—Emergency Coal Production Board		
Included in Accounts to 1944		
(*a*) Production Subsidies	$ 10,790	
(*b*) Loan	17,868	
Total Paid to March 31, 1946		
(*a*) Production Subsidies	$ 23,416	
(*b*) Loan	8,934	
Production Record		
Total Tonnage—5 years	324,309 tons	
	1940	1944
Annual Production (tons)	22,195	92,167
Per Man-Day Production (tons)	6.7	14.0
Sales Realization—per ton	$ 1.31	$ 1.49
Total Cost—per ton	1.68	1.57

SUMMARY

MANITOBA AND SASKATCHEWAN COAL COMPANY LIMITED
BIENFAIT AND TAYLORTON, SASKATCHEWAN

Capital

Issued—Common $1,000,000

Consideration for issue of
Capital—Cash, Properties $1,000,000

	1931	1944
Properties—Net Valuation	$1,265,518	$ 949,825
Net Current Position	23,258	202,705
Surplus	17,269	51,649

Earnings Record

Profits or *Losses*—14 years

(a) Before Income Tax .... $ 34,971
(b) After Income Tax *12,731*

Annual Profit or *Loss*	1931	1935	1939	1944
(a) Before Income Tax	$ 7,098	$ *3,931*	$ 964	$ 22,362
(b) After Income Tax	6,443	*3,931*	764	13,362

Dividend Record

Total Dividends Paid—14 years .... $ 41,250
Rate on Capital—2 years at 3¼ per cent, 1 year at 1½ per cent, and 1 year at 1½ per cent.

Depreciation and Depletion

Total Depreciation (14 years) charged to Operations .... $ 230,805
Total Depletion (14 years) charged to Operations 288,507

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

Production Subsidies .... $ 191,051

Total Paid to March 31, 1946

(a) Production Subsidies .... $ 242,224
(b) Grants 1,761
(c) Loans 112,032

Production Record

Total Tonnage—14 years .... 3,138,359 tons

	1931	1935	1939	1944
Annual Production (tons)	105,478	134,361	242,363	442,538
Per Man-Day Production (tons)	4.7	6.4	6.2	9.1
Sales Realization—per ton	$ 1.66	$ 1.42	$ 1.31	$ 1.40
Total Cost—per ton	1.58	1.41	1.33	1.82

SUMMARY

ROCHE PERCÉE COAL MINING COMPANY LIMITED,
ROCHE PERCÉE, SASKATCHEWAN

Incorporated 1939

Capital		
Issued—Common	$ 20,000	
Consideration for issue of Capital—Cash / Properties	$ 20,000	
		1944
Properties—Net Valuation		$ 16,595
Net Current Position		*22,779*
Deficit		*37,186*
Earnings Record		
Profits or *Losses*—5 years		
(a) Before Income Tax	$ *16,087*	
(b) After Income Tax	*16,087*	
Annual Profit or *Loss*		1944
(a) Before Income Tax		$ *6,008*
(b) After Income Tax		*6,008*
Dividend Record		
Total Dividends Paid—5 years	Nil	
Depreciation and Depletion		
Total Depreciation (5 years) charged to Operations	$ 27,285	
Total Depletion (5 years) charged to Operations	30,458	
Assistance—Emergency Coal Production Board		
Included in Accounts to 1944		
Production Subsidies Receivable	$ 21,051	
Total Paid to March 31, 1946		
Production Subsidies	$ 21,051	
Production Record		
Total Tonnage—5 years	373,839 tons	
		1944
Annual Production (tons)		105,821
Per Man-Day Production (tons)		21
Sales Realization—per ton		$ 1.30
Total Cost—per ton		1.55

SUMMARY

WESTERN DOMINION COAL MINES LIMITED, TAYLORTON, SASKATCHEWAN

Incorporated 1936; Re-organized 1939

Capital		
Issued—Common	$ 400,000	
Preferred	500,000	
Consideration for issue of		
Capital—Cash	$ 48,000	
Properties	852,000	
		1945
Properties—Net Valuation		$ 526,510
Net Current Position		523,524
Surplus		106,999
Earnings Record		
Profits—6 years		
(a) Before Income Tax	$ 130,076	
(b) After Income Tax	89,220	
Annual Profit or *Loss*	1940	1945
(a) Before Income Tax	$ *15,949*	$ *1,148*
(b) After Income Tax	*15,949*	*1,148*
Dividend Record		
Total Dividends Paid—6 years	Nil	
Depreciation and Depletion		
Total Depreciation (6 years) charged to Operations	$ 736,573	
Total Depletion (6 years) charged to Operations	387,912	
Assistance—Emergency Coal Production Board		
Included in Accounts to 1944		
Production Subsidies	Nil	
Total Paid to March 31, 1946		
Grants	$ 74,129	
Production Record		
Total Tonnage—6 years	3,879,119 tons	
	1940	1945
Annual Production (tons)	461,702	718,870
Per Man-Day Production (tons)	—	12
Sales Realization—per ton		
Stripping Coal	$ 1.09	$ 1.28
Mined Coal	1.09	1.45
Total Cost—per ton		
Stripping Coal	0.66	0.76
Mined Coal	1.20	1.62

REMARKS.—Profits for the years 1941 to 1944 after taxes amounted to $106,317. Costs per ton, are segregated between stripping and mined coal and do not include charges for administration, depreciation and depletion which are common to all production. These charges average from 35 cents to 40 cents per ton.

BITUMINOUS MINES OF ALBERTA AND SOUTH EASTERN BRITISH COLUMBIA

There are ten operating companies in this group which, during the period under review, have produced 44,352,111 tons of coal as follows:

Names of Companies	Tons produced during period
Crow's Nest Pass Coal Company Limited, Fernie, B.C....	9,016,945
Hillcrest-Mohawk Collieries Limited, Bellevue, Alta. (4⅓ years)........	1,105,687
International Coal and Coke Company Limited, Coleman, Alta........	4,709,726
McGillivray Creek Coal and Coke Company Limited, Coleman, Alta........	4,073,700
West Canadian Collieries Ltd., Blairmore and Bellevue, Alta........	8,079,424
Brazeau Collieries Limited, Nordegg, Alta........	3,118,317
Cadomin Coal Company Limited, Cadomin, Alta........	4,687,362
The Canmore Mines Limited, Canmore, Alta........	3,181,841
Luscar Coals Limited, Luscar, Alta........	2,844,994
Mountain Park Coals Limited, Mountain Park, Alta.....	3,534,115
	44,352,111

As a whole, these companies have experienced a long and satisfactory earning record. As indicated, there are ten companies in this group which, with one exception, have been in continuous operation over a long period of years. The Crow's Nest and International Companies have coking operations, and Canmore and Brazeau manufacture briquettes either for domestic or locomotive purposes.

The comparative financial position of these companies as at the end of their fiscal year in 1930 and 1944 is shown below.

—	1930	1944
	$	$
Assets—		
Properties........	33,953,057.82	39,977,071.98
Less depreciation and depletion........	12,871,934.01	20,430,539.64
	21,081,123.81	19,546,532.34
Deferred........	169,546.08	406,770.48
Net current position including investments........	7,846,062.95	8,753,874.51
	29,096,732.84	28,707,177.33
	$	$
Liabilities—		
Share Capital—		
Common........	23,414,979.66	24,566,456.66
Preferred........	450,000.00	320,240.00
Total capital........	23,864,979.66	24,886,696.66
Funded Debt........	75,555.00	60,000.00
Reserves........	1,860,455.31	1,944,658.17
Surplus—Earned........	2,344,828.51	707,450.14
—Capital........	950,914.36	1,108,372.36
	29,096,732.84	28,707,177.33

Of the outstanding capital (1944), there was issued:

For coal, lands and properties	$16,301,706.00
For cash	7,997,266.00
For stock dividends	587,724.66
	$24,886,696.66

Financial Position

These bituminous companies were almost wholly financed by the issue of share capital. Dividends during the fifteen-year period have been paid to shareholders as follows:

1930–1935	$ 6,838,703.41	being at an annual average rate of 4.77 per cent on share capital.
1936–1939	$ 2,907,490.65	being at an annual average rate of 3.06 per cent on share capital.
1940–1944	$ 2,585,846.58	being at an annual average rate of 2.08 per cent on share capital.
Total	$12,332,040.64	being at an annual average rate of 3.40 per cent on share capital.

It will be observed from the tabulation of assets and liabilities that these companies are in a strong financial position, as their total net current position amounts to almost $9,000,000. The accumulation of these funds is indicative of the policy of these operators to be prepared to meet contingencies. The companies are also able, if circumstances warrant, to divert substantial amounts to research work, with a view to possible reduction in mining costs, thereby continuing to maintain their competitive status.

Of the depreciation and depletion reserves provided of some $13,000,000 over the period, approximately $4,500,000 have been used to write off obsolete or unused plant, and of the balance about $6,000,000 have been re-invested in plant. Part of the depletion reserves have been distributed to shareholders as dividends.

Earnings

The earnings of these companies for the period under review and the return on the employed capital is as under:

Period	Earnings	Percentage of earnings to capital employed
	$	Per cent
1930–1935	3,495,212.15	2.101
1936–1939	1,702,211.36	1.623
1940–1944	3,290,528.90	2.308
	8,487,952.41	2.051

The capital employed, as referred to above, includes the values placed upon the coal lands, etc., and which in a number of instances were exchanged for shares. These values have been reduced by the accumulation of depreciation and depletion.

BITUMINOUS MINES OPERATING IN ALBERTA AND SOUTH EASTERN BRITISH COLUMBIA

SUMMARY OF OPERATING RESULTS—1930 TO 1944

—	1930 to 1935			1936 to 1939			1940 to 1944			Totals		
	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton
		Tons			Tons			Tons			Tons	
Tonnage Sold or Processed	....	12,627,154	....	....	10,153,851	....	....	21,583,206	....	....	44,364,211	....
		$	$		$	$		$	$		$	$
Realization	....	41,888,051.57	3.317	....	28,678,656.97	2.824	....	67,793,507.18	3.141	....	138,360,215.72	3.119
Deduct Costs												
Labour	54.577	21,927,522.14	1.737	57.829	16,309,221.73	1.606	60.103	39,249,001.22	1.819	57.963	77,485,745.09	1.747
Material	9.111	3,660,644.85	0.290	8.902	2,510,635.13	0.247	11.543	7,537,540.36	0.349	10.255	13,708,820.34	0.309
Power	6.732	2,704,871.91	0.214	6.195	1,747,422.62	0.172	5.164	3,372,530.62	0.156	5.853	7,824,825.15	0.176
Taxes and Rentals	1.988	798,591.94	0.063	2.295	647,195.19	0.064	1.269	828,583.81	0.038	1.701	2,274,370.94	0.051
Royalties	2.104	845,485.54	0.067	1.870	527,265.67	0.052	1.788	1,167,315.66	0.054	1.900	2,540,066.87	0.057
Workmen's Compensation Board	2.162	868.477.60	0.069	3.161	891,540.94	0.088	4.674	3,052,460.90	0.142	3.600	4,812,479.44	0.109
Other Mining Costs	3.027	1,216,102.32	0.096	2.012	567,435.01	0.056	2.305	1,505,357.10	0.070	2.460	3,288,894.43	0.074
Administration and Overhead	9.231	3,708,661.64	0.294	7.207	2,032,546.33	0.200	4.830	3,154,069.22	0.146	6.654	8,895,277.19	0.200
	88.932	35,730,357.94	2.830	89.471	25,233,262.62	2.485	91.676	59,866,858.89	2.774	90.386	120,830,479.45	2.723
Depreciation	8.290	3,330,709.55	0.263	7.134	2,011,778.82	0.198	5.128	3,348,317.84	0.155	6.501	8,690,806.21	0.196
Depletion	2.778	1,115,887.40	0.088	3.395	957,318.85	0.094	3.196	2,087,341.23	0.097	3.113	4,160,547.48	0.094
Total Cost	100.000	40,176,954.89	3.181	100.000	28,202,360.29	2.777	100.000	65,302,517.96	3.026	100.000	133,681,833.14	3.013
Operating Profit	....	1,711,096.68	0.136	....	476,296.68	0.047	....	2,490,989.22	0.115	....	4,678,382.58	0.106
Add Sundry Revenue	....	2,241,742.19	0.177	....	1,308,901.39	0.129	....	2,039,393.79	0.095	....	5,590,037.37	0.126
Coke and Briquette Profits	....	109,867.78	0.009	....	361,165.82	0.036	....	1,057,711.62	0.049	....	1,528,745.22	0.034
Subsidies	....	....	....	....	....	....	....	195,624.54	0.009	....	195,624.54	0.004
Net Profit	....	4,062,706.65	0.322	....	2,146,363.89	0.212	....	5,783,719.17	0.268	....	11,992,789.71	0.270
Deduct Income Taxes	....	567,494.50	0.045	....	444,152.53	0.044	....	2,493,190.27	0.116	....	3,504,837.30	0.079
Net Profit	....	3,495,212.15	0.277	....	1,702,211.36	0.168	....	3,290,528.90	0.152	....	8,487,952.41	0.191

Production

Production for the period has been as follows:

Period	Total production	Average annual production
	tons	tons
1930–1935	12,670,538	2,111,756
1936–1939	10,142,447	2,535,612
1940–1944	21,539,126	4,307,825
	44,352,111	2,956,807

It is worthy of note that these mines, in a national emergency during the war years when the demand for coal was at a peak, were able to almost double their previous output.

These bituminous mines produce approximately one-quarter of the present total Canadian production.

In order to permit of comparison of production in tons per man-day and the relation of per man-day output to costs, a tabulation of each is given hereunder:

——	Tons per man-day		Per ton cost		Average per ton cost	
	Highest	Lowest	Highest	Lowest	Highest	Lowest
			$	$	$	$
1932	4.41	2.59	4.545	2.603		
1933	4.09	2.52	4.607	2.721		
1934	4.40	2.94	4.007	2.571		
					(1930–1935)	
1935	4.10	2.84	4.385	2.464	3.923	2.877
1936	4.30	2.95	3.646	2.403		
1937	4.39	3.08	3.198	2.473		
1938	3.98	3.10	3.325	2.479		
					(1936–1939)	
1939	4.60	3.15	3.399	2.355	3.363	2.483
1940	4.80	3.34	3.260	2.350		
1941	4.50	3.04	2.878	2.371		
1942	4.30	3.02	3.316	2.550		
1943	4.15	2.88	4.107	2.766		
					(1940–1944)	
1944	4.32	2.68	4.361	3.097	3.571	2.790

In the thirteen years for which all figures are available the company which had the highest production per man-day in eight of the years also had the lowest per ton cost, and in four years the company with the lowest production had the highest per ton cost. It, therefore, follows that the man-day production has a vital bearing on costs.

Summary of Operations

On the previous page is a summary of the operations of these bituminous companies for the period 1930-1944, inclusive.

During the fifteen-year period under review these 10 companies sold a total of 44,364,211 tons of coal, which had a realization of $138,360,215.72, or $3.12 per ton. The cost of recovering the coal totalled $133,681,833.14, or $3.01 per

ton, leaving a profit of $4,678,382.58 on coal operations, or 3.38 per cent on sales, which equals 10.6 cents per short ton.

The total cost shown above is further analyzed as follows:

—	Per cent of cost	Amount	Per ton
		$	$
Wages	57.963	77,485,745.09	1.747
Material cost	10.255	13,708,820.34	0.309
Power cost	5.853	7,824,825.15	0.176
Taxes and rentals	1.701	2,274,370.94	0.051
Royalties	1.900	2,540,066.87	0.057
Workmen's Compensation Board	3.600	4,812,479.44	0.109
Other mining charges, including insurance, etc	2.460	3,288,894.43	0.074
Administration and overhead	6.654	8,895,277.19	0.200
	90.386	120,830,479.45	2.723
Depreciation	6.501	8,690,806.21	0.196
Depletion	3.113	4,160,547.48	0.094
Total	100.000	133,681,833.14	3.013

	Amount	Per Ton
	$	$
To the profit on coal operations of	4,678,382.58	0.106
there must be added sundry revenue of	5,590,037.37	0.126
which includes the net earnings of utilities, light, water, etc., sundry rentals, profits on stores, interest and investment earnings, etc.		
and a profit on coking and briquetting of	1,528,745.22	0.034
together with subsidies of	195,624.54	0.004
making a total net profit of	11,992,789.71	0.270
On the above profits there has been paid income taxes of	3,504,837.30	0.079
leaving a balance of	8,487,952.41	0.191
available for dividends to shareholders and working capital.		

It will be observed that approximately $4,000,000 more has been paid in dividends during this period than the net income. These additional dividends have been paid from accumulated surpluses and depletion reserves.

Sales and Costs

Using the 1936-1939 period as the base of 100, sales realization for the depression period (1930-1935) was 117.4 and costs 111.2.

During the war period comparable index figures were—sales 114.5 and costs 109. It will, therefore, be observed that the relation of realization to costs remains very constant over the whole of the fifteen-year period.

Per-ton costs which vary considerably with these companies are to a large extent governed by the physical difficulties or advantages of the properties, together with the degree to which the mines are mechanized.

Market

As the demands of the railways provide a market for approximately 75 per cent of the bituminous coal produced, these operators have had in the war years the advantage of a consistent monthly market. The increased demand of these years has resulted in a substantial increase in the days worked, and consequently in the annual production. It is, therefore, evident that, given a suitable and adequate market, by means of the present subvention assistance programme, the bituminous operations of Western Canada can be carried on successfully.

Government Assistance

The matter of transportation subventions paid by the Dominion Government is dealt with in a separate chapter of this report, as in most instances the moneys were not received by the producing companies.

Production subsidies, however, were paid by the Emergency Coal Production Board direct to the producer. During the period of such payments, the Brazeau Company claimed subsidies in the sum of $155,625, in respect of the year 1942, of which $147,231.70 was paid, while the Cadomin Company received assistance to the extent of $40,000 to be used in new development. The Hillcrest-Mohawk Company received loans from the Board, of which at the end of 1944 there was outstanding the amount of $60,000. At March 31, 1946, the liability was reduced to $33,000.

With the exception of the foregoing, the Emergency Coal Production Board have not paid any further production subsidies to the western bituminous operators up to March 31, 1946.

Record of Individual Companies

In tabulated form, significant particulars of the capital structure and operating record of each of the bituminous operators are attached hereto.

SUMMARY

CROW'S NEST PASS COAL COMPANY LIMITED, FERNIE, B.C.

Incorporated 1897

Capital				
Authorized—Common			$ 10,000,000	
Issued—Common			$ 6,212,667	
Consideration for issue of				
Capital—Cash			$ 4,368,850	
Properties			1,500,000	
Sundry—Stock Dividend			343,817	
			1930	1944
Properties—Net Valuation			$ 3,908,930	$ 3,792,247
Net Current Position			2,270,004	1,580,310
Surplus or *Deficit*			2,985	*800,560*
Earnings Record				
Profits—15 years				
(a) Before Income Tax			$ 4,098,095	
(b) After Income Tax			2,744,460	
Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ 177,492	$ 242,433	$ 199,675	$ 261,078
(b) After Income Tax	166,882	215,441	164,132	158,665

Dividend Record
- Total Dividends Paid—15 years: $ 3,602,842 ($1,340,632 from Reserves)
- Rate on Capital—(3 per cent to 7 per cent annually): 3.86 per cent

Depreciation and Depletion	
Total Depreciation (15 years) charged to Operations	$ 1,703,188
Total Depletion (15 years) charged to Operations	901,690
Assistance—Emergency Coal Production Board	
Included in Accounts to 1944	
(a) Production Subsidies	Nil
Total Paid to March 31, 1946	
(a) Production Subsidies	Nil

SUMMARY

CROW'S NEST PASS COAL COMPANY LIMITED, FERNIE, B.C.—*Concluded*

Production Record

Total Tonnage—15 years—Coal........................ 9,016,945 tons

	1930	1935	1939	1944
Annual Production (tons)	452,730	444,794	600,551	1,002,410
Per Man-Day Production (tons)	—	4.1	4.3	3.8
Sales Realization—per ton				
Coal	$ 3.586	$ 2.896	$ 2.743	$ 3.703
Coke	3.984	5.932	5.712	8.149
By-Products	—	—	5.725	8.254
Total Cost—per ton				
Coal	3.751	2.565	2.598	3.714
Coke	3.659	4.455	4.969	7.184

SUMMARY

HILLCREST-MOHAWK COLLIERIES LIMITED, BELLEVUE, ALBERTA

Incorporated 1939

Capital

Authorized—Common	$ 1,140,000
Preferred	110,000
Issued—Common	$ 1,140,000
Preferred	80,000
Consideration for issue of Capital—Properties	$ 1,220,000

	1944
Properties—Net Valuation	$ 1,290,434
Net Current Position	121,751
Surplus	105,559

Earnings Record

Profits—5 years

(a) Before Income Tax	$ 250,808
(b) After Income Tax	156,606

Annual Profit or *Loss*	1941	1942	1943	1944
(a) Before Income Tax	$ 39,776	$ 84,894	$ 49,700	$ 55,893
(b) After Income Tax	26,180	52,280	31,164	33,031

Dividend Record

Total Dividends Paid—5 years........................$ 20,000 in 1942

Depreciation and Depletion

Total Depreciation (5 years) charged to Operations	$ 131,786
Total Depletion (5 years) charged to Operations	43,303

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

(a) Production Subsidies	$ Nil
(b) Capital Loan	60,000

Total Paid to March 31, 1946

(a) Production Subsidies	$ Nil
(b) Capital Loan	33,000

Production Record

Total Tonnage—5 years—Coal........................ 1,105,686 tons

	1941	1942	1943	1944
Annual Production (tons)	196,241	290,208	281,084	277,938
Per Man-Day Production (tons)	3.93	4.24	3.72	3.64
Sales Realization—per ton	$ 2.76	$ 2.86	$ 3.02	$ 3.65
Total Cost—per ton	2.57	2.58	2.86	3.46

SUMMARY

INTERNATIONAL COAL AND COKE COMPANY LIMITED, COLEMAN, ALBERTA

Incorporated 1902, U.S.A. Re-incorporated 1919

Capital		
Authorized—Common	$ 3,000,000	
Issued—Common	$ 3,000,000	
Consideration for issue of		
Capital—Cash	$ 270,000	
Properties	2,730,000	
	1930	**1944**
Properties—Net Valuation	$ 2,573,162	$ 2,486,564
Net Current Position	603,407	1,108,288
Surplus	118,296	291,737
Earnings Record		
Profits—15 years		
(a) Before Income Tax	$ 1,342,925	
(b) After Income Tax	959,994	

Annual Profit	1930	1935	1939	1944
(a) Before Income Tax	$ 24,520	$ 23,867	$ 181,722	$ 161,250
(b) After Income Tax	22,843	22,163	143,919	89,048

Dividend Record

Total Dividends Paid—15 years .... $ 930,000

Rate on Capital—3 per cent from 1937 to 1944; 2 per cent in two prior years and 1 per cent in three years.

Depreciation and Depletion	
Total Depreciation (15 years) charged to Operations	$ 648,825
Total Depletion (15 years) charged to Operations	470,972
Assistance—Emergency Coal Production Board	
Included in Accounts to 1944	
(a) Production Subsidies	Nil
Total Paid to March 31, 1946	
(a) Production Subsidies	Nil
Production Record	
Total Tonnage—15 years	
Coal	4,709,726 tons
Coke	787,217 tons

	1930	1935	1939	1944
Annual Production (tons)	186,782	321,721	353,551	425,958
Per Man-Day Production (tons)	2.93	2.93	3.85	3.53
Sales Realization—per ton				
Coal	$ 3.50	$ 2.76	$ 2.74	$ 3.82
Coke	—	5.56	5.50	7.16
Total Cost—per ton				
Coal	3.55	2.77	2.35	3.51
Coke	—	5.67	4.88	6.93

SUMMARY

McGILLIVRAY CREEK COAL AND COKE COMPANY LIMITED, COLEMAN, ALBERTA

Capital

Authorized—Common	$ 3,000,000	
Issued—Common	$ 2,682,992	
Consideration for issue of		
Capital—Cash	$ 141,394	
Properties	2,297,690	
Sundry—Stock Dividend	243,908	

	1930	1944
Properties—Net Valuation	$ 2,078,739	$ 1,556,410
Net Current Position	347,629	538,906
Deficit	*226,917*	*523,158*

Earnings Record

Profits—15 Years	
(a) Before Income Tax	$ 984,970
(b) After Income Tax	796,197

Annual Profit	1930	1935	1939	1944
(a) Before Income Tax	$ 152,745	$ 92,184	$ 96,304	$ 6,610
(b) After Income Tax	140,356	77,841	78,700	3,606

Dividend Record

Total Dividends Paid—15 years	$ 1,140,271
Rate on Capital	2.8 per cent

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 506,829
Total Depletion (15 years) charged to Operations	407,368

Assistance—Emergency Coal Production Board

Included in Accounts to 1944	
(a) Production Subsidies	$ Nil
Total Paid to March 31, 1946	
(a) Production Subsidies	$ Nil

Production Record

Total Tonnage—15 years—Coal 4,073,700 tons

	1930	1935	1939	1944
Annual Production (tons)	276,440	312,791	297,524	249,813
Per Man-Day Production (tons)	3.00	3.12	3.40	2.82
Sales Realization—per ton	$ 3.57	$ 2.73	$ 2.69	$ 3.93
Total Cost—per ton	3.06	2.46	2.41	3.96

SUMMARY

WEST CANADIAN COLLIERIES LIMITED, BLAIRMORE, ALBERTA

Incorporated 1903

Capital		
Authorized—Common	£	720,000
Issued—Common	£	680,718
Consideration for issue of		
Capital—Cash	$	198,162
Properties		3,114,666

	1930	1944
Properties—Net Valuation	$ 3,843,820	$ 2,953,147
Net Current Position	794,527	1,305,970
Surplus	69,827	216,065
Reserves	1,256,179	730,224

Earnings Record	
Profits—15 years	
(a) Before Income Tax	$ 360,632
(b) After Income Tax	205,364

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ 3,564	$ 2,960	$ 8,730	$ 87,545
(b) After Income Tax	*738*	*6,962*	4,158	87,545

Dividend Record

Total Dividends Paid—15 years .... $ 676,000

Rate on Capital—1.25 per cent to 6.25 per cent paid for seven years.

Depreciation and Depletion	
Total Depreciation (15 years) charged to Operations	$ 2,142,240
Total Depletion (15 years) charged to Operations	732,915

Assistance—Emergency Coal Production Board	
Included in Accounts to 1944	
(a) Production Subsidies	$ Nil
Total Paid to March 31, 1946	
(a) Production Subsidies	$ Nil

Production Record

Total Tonnage—15 years—Coal .... 8,079,424 tons

	1930	1935	1939	1944
Annual Production (tons)	419,161	396,275	503,693	879,103
Per Man-Day Production (tons)	3.3	3.9	4.6	3.7
Sales Realization—per ton	$ 3.56	$ 2.86	$ 2.62	$ 3.91
Total Cost—per ton	3.76	3.02	2.72	3.92

REMARKS.—Sterling converted to Canadian dollars at par. Income tax payable for years 1943 and 1944 is not ascertained or included in foregoing figures.

SUMMARY

BRAZEAU COLLIERIES LIMITED, BRAZEAU, ALBERTA

Incorporated 1911

Capital

Issued—Common	$ 4,000,000
Preferred	240,240

Consideration for issue of

Capital—Cash	$ 240,240
Properties	4,000,000

	1930	1944
Properties—Net Valuation	$ 3,991,055	$ 4,438,855
Net Current Position	612,730	432,240
Surplus	438,215	389,152

Earnings Record
Profits—15 years

(a) Before Income Tax	$ 404,570
(b) After Income Tax	227,908

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ *8,333*	$ 71,844	$ *24,138*	$ 42,642
(b) After Income Tax	*10,600*	58,034	*24,778*	26,087

Dividend Record

Total Dividends Paid—15 years ... $ 832,274

Rate on Capital—Preference Dividends at 7 per cent and 5 per cent. Common Dividends, 1 year—½ per cent, 1 year—1½ per cent, 3 years—2 per cent and 1 year—3 per cent.

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 680,231
Total Depletion (15 years) charged to Operations	311,831

Assistance—Emergency Coal Production Board
Included in Accounts to 1944

(a) Production Subsidies (Claimed) ... $ 155,625

Total Paid to March 31, 1946

(a) Production Subsidies (Paid) ... $ 147,232

Production Record

Total Tonnage—15 years—Coal ... 3,118,317

	1930	1935	1939	1944
Annual Production (tons)	223,636	138,954	122,421	336,706
Per Man-Day Production (tons)	3.3	3.7	3.6	3.5
Sales Realization—per ton	$ 3.51	$ 3.33	$ 2.92	$ 4.40
Total Cost—per ton	3.57	3.12	3.36	4.36

SUMMARY

CADOMIN COAL COMPANY LIMITED, CADOMIN, ALBERTA

Incorporated 1917

Capital		
Authorized—Common	$ 1,200,000	N. P. V.
Issued—Common	$ 1,088,964	N. P. V.
Consideration for issue of		
Capital—Cash	$ 375,590	
Properties	1,439,350	

	1930	1944
Properties—Net Valuation	$ 1,448,930	$ 1,021,453
Net Current Position	754,477	523,413
Surplus or *Deficit*	479,641	*218,068*

Earnings Record	
Profits—15 years	
(a) Before Income Tax	$ 1,433,887
(b) After Income Tax	1,165,128

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ 107,866	$ 93,872	$ *68,993*	$ 82,211
(b) After Income Tax	99,866	73,053	*68,993*	47,425

Dividend Record

Total Dividends Paid—15 Years .... $ 2,246,584

Rate on Capital—8¼ per cent varying from 1.8 per cent to 25 per cent.

Depreciation and Depletion	
Total Depreciation (15 years) charged to Operations	$ 164,825
Total Depletion (15 years) charged to Operations	468,739

Assistance—Emergency Coal Production Board	
Included in Accounts to 1944	
(a) Production Subsidies	$ Nil
(b) Development	40,000
Total Paid to March 31, 1946	
(a) Production Subsidies	$ Nil
(b) Development	40,000

Production Record

Total Tonnage—15 years—Coal .... 4,687,362 tons

	1930	1935	1939	1944
Annual Production (tons)	394,242	323,904	236,015	266,203
Per Man-Day Production (tons)	4.4	3.6	3.4	2.7
Sales Realization—per ton	$ 3.38	$ 3.04	$ 2.86	$ 3.55
Total Cost—per ton	3.24	2.84	3.26	3.53

SUMMARY

CANMORE MINES LIMITED, CANMORE, ALBERTA

Incorporated 1886

Capital		
Authorized—Common	$ 1,000,000	
Issued—Common	$ 710,600	
Consideration for issue of Capital—Cash / Properties	$ 710,600	
	1930	1944
Properties—Net Valuation	$ 2,046,016	$ 1,633,476
Net Current Position	561,743	840,474
Surplus	1,014,542	1,099,982

Earnings Record

Profits—15 years

(a) Before Income Tax ....$ 2,166,680

(b) After Income Tax 1,489,982

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ 347,742	$ 9,352	$ 16,281	$ 308,282
(b) After Income Tax	314,024	*978*	13,510	144,160

Dividend Record

Total Dividends Paid—15 years ....$ 1,414,850

Rate on Capital—13¼ per cent, varying from 4 per cent to 25 per cent annually.

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations ....$ 586,217

Total Depletion (15 years) charged to Operations 187,350

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

Production Subsidies .... Nil

Total Paid to March 31, 1946

Production Subsidies .... Nil

Production Record

Total Tonnage—15 years—Coal .... 3,181,841 tons

	1930	1935	1939	1944
Annual Production (tons)	225,001	140,696	176,092	352,809
Per Man-Day Production (tons)	3.27	2.84	3.15	4.32
Sales Realization—per ton				
Coal	$ 4.02	$ 3.75	$ 3.41	$ 3.91
Briquettes	6.87	5.20	5.21	5.80
Total Cost—per ton				
Coal	3.57	4.39	3.39	2.98
Briquettes	6.23	4.75	3.96	4.97

REMARKS.—Administration and selling expenses for 1939 and 1944 are not included in above costs. On basis of realization these would amount to 26 cents and 40 cents for coal and briquettes in 1939, and in 1944, 19 cents and 28 cents per ton respectively.

SUMMARY

LUSCAR COLLIERIES LIMITED, LUSCAR, ALBERTA

Capital		
Issued—Common	$ 650,000	
Consideration for issue of Capital—Cash	$ 650,000	
	1930	1944
Properties—Net Valuation	$ 349,719	$ 28,488
Net Current Position	838,854	1,109,610
Surplus	342,046	143,554

Earnings Record

Profits—15 years—	
(a) Before Income Tax	$ 854,022
(b) After Income Tax	679,564

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$210,317	$ 13,726	$ *3,651*	$ 65,378
(b) After Income Tax	193,617	11,726	*3,651*	34,425

Dividend Record

Total Dividends Paid—15 years	$ 666,250

Rate on Capital—6.8 per cent, varying from $2\frac{1}{2}$ per cent to 20 per cent a year.

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 801,741
Total Depletion (15 years) charged to Operations	283,682

Assistance—Emergency Coal Production Board

Included in Accounts to 1944	
Production Subsidies	Nil
Total Paid to March 31, 1946	
Production Subsidies	Nil

Production Record

Total Tonnage—15 years	2,844,994 tons

	1930	1935	1939	1944
Annual Production (tons)	230,449	113,725	143,454	278,248
Per Man-Day Production (tons)	—	2.95	3.32	3.55
Sales Realization—per ton	$ 3.43	$ 3.34	$ 2.94	$ 3.76
Total Cost—per ton	2.76	3.67	3.27	3.70

SUMMARY

MOUNTAIN PARK COALS LIMITED, MOUNTAIN PARK, ALBERTA

Incorporated 1910

Capital

Issued—Common	$	1,042,430
Consideration for issue of Capital—Cash	$	1,042,430

	1930	1944
Properties—Net Valuation	$ 503,119	$ 345,457
Net Current Position	953,694	1,182,912
Surplus	234,428	3,188

Earnings Record

Profits—15 Years

(a) Before Income Tax	$ 1,048,393
(b) After Income Tax	891,494

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ 97,269	$160,777	$ 22,681	$ *54,302*
(b) After Income Tax	91,747	137,297	20,087	*54,302*

Dividend Record

Total Dividends Paid—15 years.....$ 802,701

Rate on Capital—5 per cent paid in 12 years varying from 2 per cent to 8 per cent.

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 699,933
Total Depletion (15 years) charged to Operations	352,696

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

Production Subsidies..... Nil

Total Paid to March 31, 1946

Production Subsidies..... Nil

Production Record

Total Tonnage—15 years..... 3,534,115 tons

	1930	1935	1939	1944
Annual Production (tons)	173,176	207,598	285,868	235,454
Per Man-Day Production (tons)	—	3.38	3.7	3.3
Sales Realization—per ton	$ 3.49	$ 3.29	$ 2.80	$ 3.74
Total Cost—per ton	3.53	2.90	2.96	4.32

DOMESTIC OPERATORS—ALBERTA DRUMHELLER FIELD

The undernoted companies are those operating in the Drumheller area which have been covered by this survey:

Companies	Tons Produced
Atlas Coal Company Limited, Drumheller (1930-1936)	756,620
Brilliant Coal Company, Drumheller (1934-1945)	859,358
Hy-Grade Coal Mining Company Limited, Drumheller (1941-1944)	423,730
Midland Coal Mining Company Limited, Drumheller (1930-1944)	2,284,437
The Monarch Coal Mining Company Limited, Drumheller (1937-1944)	715,255
Murray Collieries Limited, East Coulee (1930-1944)	1,415,923
Newcastle Collieries Limited, Drumheller (1930-1944)	913,122
Red Deer Valley Coal Company Limited, Drumheller (1935-1944)	1,050,755
Regal Coal Company Limited, East Coulee (1937-1944)	1,286,633
Rosedale Collieries Limited, Rosedale (1934-1944)	965,245
and Aerial (1934-1944)	871,421
Western Gem and Jewel Collieries Limited, Rosedale (1939-1944)	526,430
	12,068,929

Of the companies enumerated, only four (Atlas-Regal, Midland, Murray and Newcastle) have been operating over the entire fifteen-year period. In the year 1943 the companies included in this survey produced approximately 91 per cent of the coal mined in the Drumheller field.

In 1930 there were 26 companies in this area, many of which are not now in operation or in which the ownership has changed. Due to this feature, the Commission was unable to obtain their records, and the production of the field as compared with the production of the companies dealt with is as follows:

Period	Production (D. B. S.)	Production of companies surveyed	Percentage
	tons	tons	
1930–1935	7,156,629	2,454,255	34.3
1936–1939	5,118,438	2,976,333	58.1
1940–1944	7,389,602	6,495,209	87.9

Of the coal produced in Canada, the Drumheller mines produced approximately 10 per cent.

A comparative balance sheet as at the end of the 1930 period (which included four companies that have operated continuously over the fifteen-year period) and as at the end of the 1944 period (which comprises the eleven companies as named) is given herewith.

Generally speaking, the companies appear to be in a fairly sound financial position as at the present time, although some of the smaller companies in the field may experience some difficulty in financing any contingency which might arise.

BALANCE SHEET

—	1930	1944
	(4 companies)	(11 companies)
	$	$
Assets—		
Properties	909,826.93	5,884,836.91
Less depreciation and depletion reserves	121,330.27	3,301,322.03
	788,496.66	2,583,514.88
Deferred	29,042.21	134,589.90
Subsidiary companies, etc	200,046.37	104,366.05
Net current position including investments	*93,621.35*	964,708.16
	923,963.89	3,787,178.99
Liabilities—		
Share capital—common	497,937.00	1,683,607.00
—preferred	....	617,325.00
Total	497,937.00	2,300,932.00
Proprietor's equity	....	226,588.78
Funded debt	....	180,930.98
Deferred capital liability	....	34,524.37
Reserves	60,688.56	186,863.97
Surplus—earned	365,338.33	740,768.31
—capital	....	116,570.58
	923,963.89	3,787,178.99

The capital employed (book value) as at the end of 1944 for the eleven operating companies was $3,787,178, made up as follows:

Share capital, proprietors' equity and funded debt	$ 2,708,451
Deferred	34,524
Reserves and surplus	1,044,203
	$ 3,787,178

During the period, dividends or drawings in the case of proprietorships were as follows:

1930–1935	$ 100,000.00
1936-1939	50,187.19
1940-1944	401,710.59
	$ 551,897.78

Of the above, the Atlas-Regal Company paid	$ 351,329.41
The Brilliant Company (partnership) paid	136,882.37
and three other companies (Monarch, Midland and Newcastle) paid	63,686.00
	$ 551,897.78

Operating Results

From the statement on the following page, it will be seen that in the years 1930-1944, inclusive, these companies sold a total of 11,920,076 tons having a value of $34,540,177, or $2.898 per ton.

COMPANIES OPERATING IN ALBERTA—DRUMHELLER FIELD

SUMMARY OF OPERATING RESULTS—1930 TO 1944

—	1930 to 1935 (4 to 7 Companies)			1936 to 1939 (7 to 10 Companies)			1940 to 1944 (10 to 11 Companies)			Totals		
	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton
		Tons			Tons			Tons			Tons	
Tonnage Sold or Processed	....	2,453,715	....	....	2,974,730	....	....	6,491,631	....	....	11,920,076	....
		$	$		$	$		$	$		$	$
Realization	....	6,577,686.97	2.681	....	7,814,051.56	2.627	....	20,148,438.91	3.104	....	34,540,177.44	2.898
Deduct Costs												
Labour	54.145	3,302,799.28	1.346	59.180	4,614,962.40	1.552	59.411	11,719,794.92	1.806	58.401	19,637,556.60	1.648
Material	5.486	334,661.53	0.136	5.570	434,333.83	0.146	7.055	1,391,649.74	0.214	6.426	2,160,645.10	0.181
Power	1.941	118,388.90	0.048	2.580	201,199.12	0.068	2.510	495,058.87	0.076	2.423	814,646.89	0.068
Taxes and Rentals	5.516	336,462.91	0.138	2.911	226,976.19	0.076	1.655	326,398.93	0.050	2.646	889,838.03	0.075
Royalties	2.427	148,059.07	0.060	3.007	234,467.11	0.079	3.081	607,886.21	0.094	2.946	990,412.39	0.083
Workmen's Compensation Board	2.263	138,024.63	0.056	3.098	241,594.23	0.081	4.736	934,261.22	0.144	3.908	1,313,880.08	0.110
Other Mining Costs	5.870	358,089.90	0.146	5.410	421,853.63	0.142	4.626	912,586.16	0.141	5.034	1,692,529.69	0.142
Administration and Overhead	14.060	857,655.00	0.350	10.355	807,494.83	0.271	8.436	1,664,055.44	0.256	9.901	3,329,205.27	0.279
Rental—Affiliated Company	....	....	....	1.650	128,715.22	0.043	3.566	703,468.02	0.108	2.475	832,183.24	0.070
	91.708	5,594,141.22	2.280	93.761	7,311,596.56	2.458	95.076	18,755,159.51	2.889	94.160	31,660,897.29	2.656
Depreciation	6.621	403,902.05	0.165	3.854	300,565.47	0.101	2.860	564,306.65	0.087	3.773	1,268,774.17	0.106
Depletion	1.671	101,911.58	0.041	2.385	186,014.15	0.063	2.064	406,937.42	0.063	2.067	694,863.15	0.059
Total Cost	100.000	6,099,954.85	2.486	100.000	7,798,176.18	2.622	100.000	19,726,403.58	3.039	100.000	33,624,534.61	2.821
Operating Profit	......	477,732.12	0.195	....	15,875.38	0.005	....	422,035.33	0.065	....	915,642.83	0.077
Add Sundry Revenue	....	138,524.10	0.056	....	127,187.40	0.043	....	300,304.23	0.046	....	566,015.73	0.047
Subsidies	....	....	....	....	....	....	....	164,818.02	0.025	....	164,818.02	0.014
Profit, before Income Tax	....	616,256.22	0.251	....	143,062.78	0.048	....	887,157.58	0.136	....	1,646,476.58	0.138
Income Taxes	....	18,130.44	0.007	....	8,470.85	0.003	....	391,482.56	0.060	....	418,083.85	0.035
Net Profit	....	598,125.78	0.244	....	134,591.93	0.045	....	495,675.02	0.076	....	1,228,392.73	0.103
Depletion is not set up in all Companies. If entered at 10 cents on production, a further depletion charge would be made of	....	143,513.92	0.058	....	111,619.15	0.038	....	242,583.48	0.037	....	497,716.55	0.042
Making a Net Profit of	....	454,611.86	0.186	....	22,972.78	0.007	....	253,091.54	0.039	....	730,676.18	0.061

The total cost of recovering the coal amounted to $33,624,534.61, or $2.821 per ton. To increase the depletion entered in the books to 10 cents per ton, an additional charge of $497,716.55 would be necessary, which amounts to $0.042 per ton. After making such adjustment, the operating profit amounts to $417,926.28, being 1.21 per cent on sales, or $0.035 per ton after charging 10 cents per ton depletion.

The total cost shown above is further analyzed as follows:

—	Percent of cost	Amount	Per ton
		$	$
Labour	58.401	19,637,556.60	1.648
Material	6.426	2,160,645.10	0.181
Power	2.423	814,646.89	0.068
Taxes and rentals	2.646	889,838.03	0.075
Royalties	2.946	990,412.39	0.083
Workmen's Compensation Board	3.908	1,313,880.08	0.110
Other mining costs	5.034	1,692,529.69	0.142
Administration	9.901	3,329,205.27	0.279
Rental—affiliated company	2.475	832,183.24	0.070
	94.160	31,660,897.29	2.656
Depreciation	3.773	1,268,774.17	0.106
Depletion	2.067	694,863.15	0.059
	100.000	33,624,534.61	2.821

Details of the above costs segregated into the three periods are shown on the facing page.

	$	$
To the profit on coal operations of	915,642.83	0.077
there must be deducted additional depletion of	497,716.55	0.042
to bring the profit after depletion of 10 cents per ton to	417,926.28	0.035
to this is added sundry revenue of	566,015.73	0.047
and government subsidies of	164,818.02	0.014
leaving a net profit before income taxes of	1,148,760.03	0.096
the income taxes amount to	418,083.85	0.035
which leaves a net profit for all the companies of	730,676.18	0.061

Government Assistance

The following production subsidies have been paid:—

Company	Total to 31st March 1946	To end of 1944	1945 to 31st March, 1946
	$	$	$
Hy-Grade	90,487.04	37,057.56	53,429.48
Monarch	59,786.80	25,812.37	33,974.43
Rosedale	108,517.41	26,851.11	81,666.30
Western Gem	124,475.37	75,096.98	49,378.39
	383,266.62	164,818.02	218,448.60
Companies not in survey	185,757.83		

In addition the undernoted government assistance was made by way of loans outstanding and grants to March 31, 1946.

—	Loans	Grants
	$	$
Midland Company	32,655.26	....
Monarch Company	8,797.67	....
Red Deer Valley	5,589.32	....
Rosedale	20,000.00	39,886.37
	67,042.25	39,886.37
Companies not included in survey	4,000.00	2,000.00

Sales

Using the 1936-1939 period as a base of 100, the sales realization in comparison therewith was 102 in the depression period (1930-1935) and 118 in the war years (1940-1944).

A comparison of costs for the same periods is 95.6 and 115.6. As costs did not rise in proportion to the sales realization, the Drumheller field as a whole experienced fairly satisfactory earnings in the war years, and out of the eleven companies surveyed only four required subsidies in the year 1944.

Production and Costs

Using representative years for purposes of comparison, the costs per ton (including depletion at 10 cents per ton) and the per-man-day production are as follows:

1930		1935		1939		1944	
High cost	Low cost	High cost	Low cost	High cost	Low cost	High cost	Low cost
$	$	$	$	$	$	$	$
2.75	2.07	3.08	2.28	3.06	1.66	4.52	2.30

Production—Tons per Man-Day.

1930		1935		1939		1944	
High	Low	High	Low	High	Low	High	Low
tons	tons	tons	tons	tons	tons	tons	tons
6.90	3.98	6.20	2.85	6.00	2.88	4.40	2.55

In eleven of the fifteen years the company with the highest cost also has the lowest man-day production, and in ten years the company with the lowest cost experienced the highest man-day production.

The Atlas-Regal companies have had a very high production record in this field; the lowest production of 4.3 tons was in the year 1944 and the high was 8.4 tons in the years 1931 and 1932, with an over-all average of 6 tons per man-day. These companies are the most profitable and are in the strongest financial position in the Drumheller District.

Record of Individual Companies

Attached hereto, in tabulated form, are significant particulars of capital structure and operating record of each of the companies surveyed in this field.

SUMMARY

ATLAS COAL COMPANY LIMITED, EAST COULEE, ALBERTA

Incorporated 1930

REGAL COAL COMPANY LIMITED, KNEEHILL, ALBERTA

Incorporated 1932

Capital		
Authorized—Common	$ 70,000	
Issued— Common	$ 70,000	
Consideration for issue of		
Capital—Cash	$ 20,000	
Properties	50,000	
	1930	1944
Properties—Net Valuation	$ 159,332	$ 298,972
Net Current Position	*9,904*	457,520
Surplus	122,493	559,625

Earnings Record

Profits or *Losses*—15 years

(a) Before Income Tax	$1,210,266
(b) After Income Tax	865,080

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$122,036	$ 5,352	$ 93,211	$ 96,719
(b) After Income Tax	122,036	3,159	86,141	58,719

Dividend Record

Total Dividends Paid—15 years .... $ 351,329

Rate on Capital—In 1932 dividend paid of $100,000.
In 1943 dividend paid of 251,329.

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 340,694
Total Depletion (15 years) charged to Operations	172,843

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

Production Subsidies .... Nil

Total Paid to March 31, 1946

Production Subsidies .... Nil

Production Record

Total Tonnage—15 years .... 2,043,253 tons

	1930	1935	1939	1944
Annual Production (tons)	110,789	105,234	138,318	171,308
Per Man-Day Production (tons)	6.9	6.2	6.0	4.3
Sales Realization—per ton	$ 3.15	$ 2.47	$ 2.74 2.92	$ 4.09 3.57
Total Cost—per ton	2.07	2.52	2.66 1.66	3.93 2.30

Remarks.—Costs for the years 1939 and 1944 are shown for the Kneehill and East Coulee mines and are exclusive of administration and selling expenses which amount to 42 cents per ton over both mines for 1939 and 37 cents in 1944.

SUMMARY

BRILLIANT COAL COMPANY LIMITED, DRUMHELLER, ALBERTA

PARTNERSHIP

Commenced 1933

			1944
Properties—Net Valuation			$ 62,750
Net Current Position			144,348
Partners' Capital			226,588

Earnings Record

Profits or *Losses*—12 years	
(a) Before Income Tax	$ 415,809
(b) After Income Tax	337,918

Annual Profit or *Loss*	1935	1939	1944
(a) Before Income Tax	$ 5,585	$ 38,884	$ 53,551
(b) After Income Tax	4,485	—	45,803

Partners' Drawings	$ 136,882

Depreciation and Depletion

Total Depreciation (12 years) charged to Operations	$ 71,588
Total Depletion (12 years) charged to Operations	34,654

Assistance—Emergency Coal Production Board

Included in Accounts to 1944	
Production Subsidies	$ Nil
Total Paid to March 31, 1946	
Production Subsidies	$ Nil

Production Record

Total Tonnage—12 years	859,358 tons

	1935	1939	1944
Annual Production (tons)	45,201	66,160	98,851
Per Man-Day Production (tons)	3.8	3.7	4.4
Sales Realization—per ton	$ 2.66	$ 2.90	$ 3.75
Total Cost—per ton	2.57	2.36	3.31

SUMMARY

HY-GRADE COAL MINING COMPANY LIMITED, DRUMHELLER, ALBERTA

Incorporated 1940

Capital		
Authorized—Common	$ 24,000	
Issued— Common	$ 24,000	
Consideration for issue of Capital—Cash	$ 24,000	
		1944
Properties—Net Valuation		$ 51,727
Net Current Position		*768*
Deficit		*2,924*
Earnings Record		
Profits or *Losses*—4 years		
(*a*) Before Income Tax	$ 2,802	
(*b*) After Income Tax	2,802	
Annual Profit or *Loss*		1944
(*a*) Before Income Tax		$ *2,521*
(*b*) After Income Tax		*2,521*
Dividend Record		
Total Dividends Paid—4 years	Nil	
Depreciation and Depletion		
Total Depreciation (4 years) charged to Operations		$ 12,647
Total Depletion (4 years) charged to Operations		12,155
Assistance—Emergency Coal Production Board		
Included in Accounts to 1944		
Production Subsidies	$ 43,064	
Total Paid to March 31, 1946		
Production Subsidies	$ 90,487	
Production Record		
Total Tonnage—4 years	423,730 tons	
		1944
Annual Production (tons)		99,053
Per Man-Day Production (tons)		2.95
Sales Realization—per ton		$ 3.51
Total Cost—per ton		4.01

SUMMARY

MIDLAND COAL MINING COMPANY LIMITED, MIDLANDVALE, ALBERTA

Capital

Authorized—Common	$ 50,000
Issued— Common	$ 50,000
Consideration for issue of Capital—Cash / Properties	$ 50,000

	1930	1944
Properties—Net Valuation	$ 271,052	$ 305,772
Net Current Position	*35,393*	62,976
Surplus	183,948	322,122

Earnings Record

Profits—15 years	
(a) Before Income Tax	$ 387,932
(b) After Income Tax	252,964

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ 94,090	$ *7,680*	$ *9,546*	$ 62,211
(b) After Income Tax	90,600	*7,680*	*9,546*	44,388

Dividend Record

Total Dividends Paid—15 years	$ 20,000

Rate on Capital—1 year at 40 per cent.

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 350,923
Total Depletion (15 years) charged to Operations	112,501

Assistance—Emergency Coal Production Board

Included in Accounts to 1944	
Production Subsidies	Nil
Total Paid to March 31, 1946	
(a) Production Subsidies	Nil
(b) Loan	$ 32,655

Production Record

Total Tonnage—15 years	2,284,437 tons

	1930	1935	1939	1944
Annual Production (tons)	178,973	149,871	98,432	206,801
Per Man-Day Production (tons)	3.98	4.28	4.16	4.03
Sales Realization—per ton	$ 3.21	$ 2.41	$ 2.66	$ 3.41
Total Cost—per ton	2.75	2.49	2.80	3.14

REMARKS.—Depletion is included in the above costs as follows:
1930 and 1935 at 5 cents per ton. 1939—10 cents per ton. 1944—Nil.

SUMMARY

MONARCH COAL MINING COMPANY LIMITED, DRUMHELLER, ALBERTA

Incorporated 1936

Capital		
Authorized—Common	$ 65,000	
Preferred	37,500	
Issued— Common	$ 45,000	
Preferred	17,325	
Consideration for issue of Capital—Cash, Properties	$ 62,325	
		1944
Properties—Net Valuation		$ 168,444
Net Current Position		38,512
Surplus		64,569
Earnings Record		
Profits or *Losses*—8 years		
(a) Before Income Tax	$ 84,059	
(b) After Income Tax	75,411	
(c) Taxable Income	19,182	
Annual Profit	1939	1944
(a) Before Income Tax	$ 2,909	$ 11,264
(b) After Income Tax	2,909	11,264
Dividend Record		
Total Dividends Paid—8 years	$ 3,397	
Rate on Capital—4 per cent on preferred shares for 5 years.		
Depreciation and Depletion		
Total Depreciation (8 years) charged to Operations	$ 147,188	
Total Depletion (8 years) charged to Operations	Nil	
Assistance—Emergency Coal Production Board		
Included in Accounts to 1944		
(a) Production Subsidies	$ 25,812	
Total Paid to March 31, 1946		
(a) Production Subsidies	$ 59,787	
(b) Loans	8,797	
Production Record		
Total Tonnage—8 years	715,255 tons	
	1939	1944
Annual Production (tons)	68,135	123,684
Per Man-Day Production (tons)	4.4	3.9
Sales Realization—per ton	$ 2.97	$ 3.41
Total Cost—per ton	2.93	3.54

SUMMARY

MURRAY COLLIERIES LIMITED, EAST COULEE, ALBERTA

Capital

Authorized—Common	$ 100,000
Issued— Common	$ 100,000
Consideration for issue of Capital—Cash	$ 100,000

	1930	1944
Properties—Net Valuation	$ 243,663	$ 116,131
Net Current Position	*74,681*	97,803
Surplus	28,982	92,843

Earnings Record

Profits or *Losses*—15 years

(a) Before Income Tax	$ 284,106
(b) After Income Tax	193,288

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ 23,890	$ 1,026	$ 381	$ 29,519
(b) After Income Tax	23,890	1,026	381	17,519
(c) Taxable Income	3,599	*19,642*	*6,234*	29,519

Dividend Record

Total Dividends Paid—15 years	Nil

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 203,477
Total Depletion (15 years) charged to Operations	34,603

Assistance—Emergency Coal Production Board

Included in Accounts to 1944 Production Subsidies	Nil
Total Paid to March 31, 1946 Production Subsidies	Nil

Production Record

Total Tonnage—15 years	1,415,923 tons

	1930	1935	1939	1944
Annual Production (tons)	64,793	53,452	83,842	150,508
Per Man-Day Production (tons)	—	4.85	4.94	4.25
Sales Realization—per ton	$ 2.67	$ 2.24	$ 2.48	$ 3.35
Total Cost—per ton	2.33	2.57	2.52	3.18

REMARKS.—For taxation purposes a loss is shown for 10 years and in the other 5 a taxable profit of $169,671.

SUMMARY

NEWCASTLE COLLIERIES LIMITED, DRUMHELLER, ALBERTA

	1930	1944
Capital		
Issued—Common	$ 298,437	
Properties—Net Valuation	$ 114,449	$ 122,485
Net Current Position	26,357	141,661
Surplus or *Deficit*	29,915	*24,130*

Earnings Record

Profits or *Losses*—15 years

(a) Before Income Tax	$ 28,540
(b) After Income Tax	*37,990*

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ *15,091*	$ 1,440	$ 11,843	$ 14,738
(b) After Income Tax	*15,091*	1,403	8,976	8,843

Dividend Record

Total Dividends Paid—15 years ..... $ 40,289

Rate on Capital—2½ per cent for 1 year, 3 per cent in 2 years, and 5 per cent for 1 year.

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 86,323
Total Depletion (15 years) charged to Operations	85,772

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

Production Subsidies	Nil

Total Paid to March 31, 1946

Production Subsidies	Nil

Production Record

Total Tonnage—15 years ..... 913,122 tons

	1930	1935	1939	1944
Annual Production (tons)	49,341	45,592	65,930	110,135
Per Man-Day Production (tons)	—	3.6	3.7	3.5
Sales Realization—per ton	$ 2.93	$ 2.69	$ 2.78	$ 3.73
Total Cost—per ton	3.43	2.71	2.65	3.63

SUMMARY

RED DEER VALLEY COAL COMPANY LIMITED, DRUMHELLER, ALBERTA

Commenced 1934

Capital			
Issued—Common		$ 346,170	
Consideration for issue of			
Capital—Cash		$ 58,200	
Properties		287,970	
		1935	1944
Properties—Net Valuation		$ 368,474	$ 297,514
Net Current Position		32,998	150,242
Deficit		*81,872*	*77,286*
Earnings Record			
Profits or *Losses*—10 years			
(a) Before Income Tax		$ 72,576	
(b) After Income Tax		13,111	
Annual Profit or *Loss*	1935	1939	1944
(a) Before Income Tax	$ *4,451*	$ 4,357	$ 26,032
(b) After Income Tax	*4,451*	3,482	15,611
Dividend Record			
Total Dividends Paid—10 years		Nil	
Depreciation and Depletion			
Total Depreciation (10 years) charged to Operations		$ 114,552	
Total Depletion (10 years) charged to Operations		105,075	
Assistance—Emergency Coal Production Board			
Included in Accounts to 1944			
Production Subsidies		Nil	
Total Paid to March 31, 1946			
(a) Production Subsidies		$ Nil	
(b) Loans		5,589	
Production Record			
Total Tonnage—10 Years		1,050,755 tons	
	1935	1939	1944
Annual Production (tons)	47,002	61,645	206,250
Per Man-Day Production (tons)	2.85	3.8	3.5
Sales Realization—per ton	$ 2.92	$ 3.05	$ 3.51
Total Cost—per ton	3.08	3.06	3.56

SUMMARY

ROSEDALE COLLIERIES LIMITED, ROSEDALE, ALBERTA

Incorporated 1933

Capital			
Authorized—Common		$ 600,000	
Issued— Common		$ 600,000	
Consideration for issue of Capital—Properties		$ 600,000	
		1933	1944
Properties—Net Valuation		$ 743,146	$ 615,477
Net Current Position		22,714	49,144
Deficit		—	*44,743*
Earnings Record			
Losses—11 years			
(a) Before Income Tax		$ *44,743*	
(b) After Income Tax		*44,743*	
Annual *Loss*	1935	1939	1944
(a) Before Income Tax	$ *199*	$ *136*	$ *8,209*
(b) After Income Tax	*199*	*136*	*8,209*
Dividend Record			
Total Dividends Paid—11 years		Nil	
Depreciation and Depletion			
Total Depreciation (11 years) charged to Operations		$ 108,905	
Total Depletion (11 years) charged to Operations		85,230	
Assistance—Emergency Coal Production Board			
Included in Accounts to 1944			
Production Subsidies		$ 30,632	
Total Paid to March 31, 1946			
(a) Production Subsidies		$ 108,517	
(b) Grants for Development Work		39,886	
(c) Loan		20,000	
Production Record			
Total Tonnage—11 years—			
Rosedale Mine		965,245 tons	
Star Mine		871,421 tons	
Annual Production (tons)—	1935	1939	1944
Rosedale Mine	88,038	70,978	86,926
Star Mine	56,696	83,712	133,595
Per Man-Day Production (tons)—			
Rosedale Mine	—	2.88	2.64
Star Mine	2.97	3.40	3.31
Sales Realization—per ton—			
Rosedale Mine	$ 2.48	$ 2.70	$ 3.49
Star Mine	2.46	2.73	3.56
Total Cost—per ton—			
Rosedale Mine	$ 2.28	$ 2.80	$ 3.71
Star Mine	2.44	2.22	2.97

REMARKS.—Costs as shown are before depreciation, depletion, head office expense and bond interest which are not allocated to mining costs by the Company.

SUMMARY

WESTERN GEM AND JEWEL COLLIERIES LIMITED, CAMBRIA, ALBERTA

Incorporated 1937

Capital		
Issued—Common	$	150,000
Preferred		600,000
Consideration for issue of Capital—Properties	$	750,000

	1938	1944
Properties—Net Valuation	$ 675,132	$ 544,241
Net Current Position	34,725	59,399
Deficit	*29,736*	*149,308*

Earnings Record		
Losses—6 years		
(a) Before Income Tax	$	*111,317*
(b) After Income Tax		*111,317*

Annual *Loss*	1939	1944
(a) Before Income Tax	$ *7,720*	$ *8,965*
(b) After Income Tax	*7,720*	*8,965*

Dividend Record	
Total Dividends Paid—6 years	Nil
Depreciation and Depletion	
Total Depreciation (6 years) charged to Operations	$ 86,687
Total Depletion (6 years) charged to Operations	52,642
Assistance—Emergency Coal Production Board	
Included in Accounts to 1944	
Production Subsidies	$ 82,318
Total Paid to March 31, 1946	
Production Subsidies	$ 124,475
Production Record	
Total Tonnage—6 years	526,430 tons

	1939	1944
Annual Production (tons)	92,250	81,439
Per Man-Day Production (tons)	3.7	2.55
Sales Realization—per ton	$ 2.69	$ 3.36
Total Cost—per ton	2.84	4.52

COMPANIES OPERATING IN NORTHERN ALBERTA

The following are the companies operating in areas adjacent to Edmonton, Alberta:

	Production
Banner Coals Limited, Edmonton (7 years)	295,312 tons
Beverley Coal Company Limited, Beverley (11 years)	562,985 tons
Edmonton Collieries Limited, Edmonton (4 years)	81,060 tons
The Great West Coal Company Limited, Edmonton (15 years)	1,131,658 tons
Kent Coal Company Limited, Edmonton (10 years)	604,504 tons
Lakeside Coals Limited, Edmonton (15 years)	1,250,190 tons
Red Flame Coal Company Limited, Camrose (4 years)	109,985 tons
	4,035,694 tons

As there were only two of the above companies operating in 1930, a summary of the balance sheets as at 1935 and 1944 is undernoted:

—	1935	1944
	$	$
Assets—		
Properties, including valuation of coal lands, plant, equipment, etc.	1,124,654.93	1,463,171.52
Less reserve for depreciation and depletion	177,574.32	682,396.49
	947,080.61	780,775.03
Deferred	3,106.95	6,685.93
Subsidiaries	15,503.00	17,304.00
Net current position	130,432.38	162,191.94
	1,096,122.94	966,956.90
	1935	1944
Liabilities—		
Capital—Common Shares	977,782.00	1,018,282.00
Affiliated companies, etc	28,644.17	57,903.16
Reserves	25,500.00	5,053.95
Surplus or *Deficit*	64,196.77	*132,508.45*
Capital	....	18,226.24
	1,096,122.94	966,956.90

COMPANIES OPERATING IN NORTHERN ALBERTA

SUMMARY OF OPERATING RESULTS—1930 TO 1944

—	1930 to 1935			1936 to 1939			1940 to 1944			Totals		
	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton
		Tons			Tons			Tons			Tons	
Tonnage Sold	....	1,030,274	....	....	1,063,228	....	....	1,942,192	....	....	4,035,694	....
		$	$		$	$		$	$		$	$
Realization	....	2,281,134.54	2.214	....	2,233,846.31	2.101	....	4,899,274.96	2.523	....	9,414,255.81	2.333
Deduct Costs												
Labour	64.758	1,508,538.41	1.464	61.761	1,428,658.84	1.344	61.614	3,180,056.39	1.637	62,395	6,117,253.64	1.516
Material	10.367	241,504.27	0.234	8.686	200,920.40	0.189	8.208	423,618.72	0.218	8.834	866,043.39	0.215
Power	1.597	37,211.23	0.036	3.205	74,130.76	0.070	3.539	182,677.91	0.094	2.999	294,019.90	0.073
Taxes and Rentals	1.356	31,582.88	0.031	1.195	27,646.84	0.026	1.053	54,351.73	0.028	1.159	113,581.45	0.028
Royalties	5.488	127,831.51	0.124	5.728	132,499.68	0.125	4.239	218,809.87	0.113	4.887	479,141.06	0.119
Workmen's Compensation Board	3.119	72,653.85	0.071	3.338	77,223.00	0.073	5.023	259,262.85	0.133	4.173	409,139.70	0.101
Other Mining Costs	1.643	38,266.70	0.037	3.816	88,264.30	0.083	5.621	290,144.84	0.149	4.250	416,675.84	0.103
Administration and Overhead	9.500	221,301.74	0.215	9.235	213,635.15	0.201	6.176	318,759.26	0.164	7.688	753,696.15	0.187
	97.828	2,278,890.59	2.212	96.964	2,242,978.97	2.111	95.473	4,927,681.57	2.536	96.385	9,449,551.13	2.342
Depreciation	2.172	50,601.64	0.049	3.036	70,242.52	0.065	4.061	209,566.22	0.108	3.370	330,410.38	0.082
Depletion	....	....	....	....	....	....	0.466	24,051.50	0.013	0.245	24,051.50	0.005
Total Costs	100.000	2,329,492.23	2.261	100.000	2,313,221.49	2.176	100.000	5,161,299.29	2.657	100.000	9,804,013.01	2.429
Loss on Operations	....	*48,357.69*	*0.047*	....	*79,375.18*	*0.075*	....	*262,024.33*	*0.134*	....	*389,757.20*	*0.096*
Add Sundry Revenue	....	101,151.40	0.098	....	73,096.87	0.069	....	91,795.39	0.047	....	266,043.66	0.066
Subsidies	....	....	....	....	....	....	....	247,228.39	0.127	....	247,228.39	0.061
Profit or *Loss* before Income Tax	....	52,793.71	0.051	....	*6,278.31*	*0.006*	....	76,999.45	0.040	....	123,514.85	0.031
Deduct Income Taxes	....	6,840.88	0.007	....	2,331.10	0.002	....	16,785.89	0.009	....	25,957.87	0.006
Profit or *Loss* after Income Tax	....	45,952.83	0.044	....	*8,609.41*	*0.008*	....	60,213.56	0.031	....	97,556.98	0·025
If Depletion were entered at 10 cents per ton, an additional charge would be necessary of	....	103,027.40	0.100	....	106,322.80	0.100	....	170,167.70	0.088	....	379,517.90	0.095
Making a net result of	....	*57,074.57*	*0.056*	....	*114,932.21*	*0.108*	....	*109,954.14*	*0.057*	....	*281,960.92*	*0.070*

Depletion is set up in the books by only two of the companies (Red Flame and Lakeside) and this is in the last period (1940-1944). If depletion were entered at 10 cents per ton by all companies, the fixed assets as noted above would be reduced and the deficit increased by $379,517.90.

Most of these companies are in only fair financial condition, as the Great West Company owns approximately 65 per cent of the total current assets. The Banner and Kent Companies have a deficiency of working capital and are financed by other affiliated companies.

The Great West Company, with a capital stock of $127,500, has paid dividends of 16 per cent in 1930 and approximately 3 per cent in four of the years and approximately 4 per cent in two other years, for a total of $44,916.66.

A dividend was paid by the Red Flame Company in 1944 at the rate of 20 per cent in the amount of $2,700 on a capital of $13,500. This company has been in operation for four years.

Operating Results

A summary of the results over the period is sh wn on the facing page, and after all charges, subsidies, et cetera, are included an over-all loss of 7 cents per ton is shown.

With the exception of two small producers which incorporated during 1941, these operators show consistent losses throughout the period. Sundry revenue averages 7 cents per ton and reduces the operating loss of 10 cents to 3 cents per ton.

It will be observed that the realization of these mines is comparatively low, being at an average value of $2.33 per ton, while costs before charging depreciation or depletion amount to $2.34 per ton.

Using representative years for purposes of comparison, the costs per ton and the per man-day production are as follows:

1930		1935		1939		1944	
High cost	Low cost	High cost	Low cost	High cost	Low cost	High cost	Low cost
$	$	$	$	$	$	$	$
2.75	2.58	2.42	1.87	2.65	1.77	4.40	2.49

PRODUCTION IN TONS PER MAN-DAY

1935		1939		1944	
High	Low	High	Low	High	Low
tons	tons	tons	tons	tons	tons
4.65	3.10	4.20	3.15	3.94	2.41

Government Assistance

Dominion Government assistance in this field (other than subventions) is enumerated hereunder:

—	Total production subsidy to March 31, 1946	Production subsidy to 1944	Loans outstanding to March 31, 1946
	$	$	$
Companies (7) included in survey	546,053.59	247,228.39	29,026.64
Companies (12) not included in survey	175,683.46	....	37,529.53
	721,737.05	247,228.39	66,556.17

Record of Individual Companies

Attached hereto, in tabular form, are significant particulars of the capital structure and operating record of each of the companies surveyed in this field.

SUMMARY

BANNER COALS LIMITED, EDMONTON, ALBERTA

Incorporated 1937

Capital		
Issued—Common	$ 20,000	
Consideration for issue of Capital—Mining Rights	$ 20,000	
	1938	1944
Properties—Net Valuation	$ 51,207	$ 54,189
Net Current Position	*2,142*	1,975
Deficit	*181*	*3,039*
Earnings Record		
Profits or *Losses*—7 years		
(a) Before Income Tax	$ *2,984*	
(b) After Income Tax	*3,592*	
Annual *Loss*	1939	1944
(a) Before Income Tax	$ *331*	$ *3,709*
(b) After Income Tax	*331*	*4,317*
Dividend Record		
Total Dividends Paid—7 years	Nil	
Depreciation and Depletion		
Total Depreciation (7 years) charged to Operations	$ 11,124	
Total Depletion (7 years) charged to Operations	Nil	
Assistance—Emergency Coal Production Board		
Included in Accounts to 1944		
(a) Production Subsidies (Receivable $6,619)	$ 26,319	
(b) Loans	9,909	
Total Paid to March 31, 1946		
(a) Production Subsidies	$ 102,747	
(b) Loans	5,913	
Production Record		
Total Tonnage—7 years	295,312 tons	
	1939	1944
Annual Production (tons)	35,352	54,891
Sales Realization—per ton	$ 1.81	$ 2.59
Total Cost—per ton	1.84	3.16

SUMMARY

BEVERLEY COAL COMPANY LIMITED, BEVERLEY, ALBERTA

Incorporated 1933

Capital			
Issued—Common		$ 200,000	
Consideration for issue of Capital—Properties		$ 200,000	
		1934	1944
Properties—Net Valuation		$ 203,772	$ 184,648
Net Current Position		6,010	33,970
Surplus or *Deficit*		*811*	18,619
Earnings Record			
Profits—11 years			
(a) Before Income Tax		$ 19,085	
(b) After Income Tax		18,319	
Annual Profit or *Loss*	1935	1939	1944
(a) Before Income Tax	$ *104*	$ 2,305	$ *4,866*
(b) After Income Tax	*104*	2,166	*4,866*
Dividend Record			
Total Dividends Paid—11 years		Nil	
Depreciation and Depletion			
Total Depreciation (11 years) charged to Operations		$ 57,900	
Total Depletion (11 years) charged to Operations		Nil	
Assistance—Emergency Coal Production Board			
Included in Accounts to 1944			
Production Subsidies (Receivable $1,733)		$ 38,618	
Total Paid to March 31, 1946			
Production Subsidies		$ 82,369	
Production Record			
Total Tonnage—11 years		562,985 tons	
	1935	1939	1944
Annual Production (tons)	40,587	56,825	31,556
Per Man-Day Production (tons)	3.9	4.2	2.8
Sales Realization—per ton	$ 2.37	$ 2.23	$ 2.99
Total Cost—per ton	$ 2.42	$ 2.22	$ 4.40

SUMMARY

EDMONTON COLLIERIES LIMITED, EDMONTON, ALBERTA

Incorporated 1940

Capital		
Issued—Common	$ 7,000	
Consideration for issue of Capital—Cash	$ 7,000	
		1944
Properties—Net Valuation		$ 8,846
Net Current Position		4,165
Surplus		6,777
Earnings Record		
Profits—4 years		
(a) Before Income Tax	$ 7,556	
(b) After Income Tax	5,107	
Annual Profit		1944
(a) Before Income Tax		$ 3,013
(b) After Income Tax		1,801
Dividend Record		
Total Dividends Paid—4 years	Nil	
Depreciation and Depletion		
Total Depreciation (4 years) charged to Operations	$ 2,514	
Total Depletion (4 years) charged to Operations	Nil	
Assistance—Emergency Coal Production Board		
Included in Accounts to 1944		
Production Subsidies	$ 4,780	
Total Paid to March 31, 1946		
(a) Production Subsidies	$ 14,646	
(b) Loans	3,959	
Production Record		
Total Tonnage—4 Years	81,060 tons	
		1944
Annual Production (tons)		23,818
Per Man-Day Production (tons)		3.9
Sales Realization—per ton		$ 2.41
Total Cost—per ton		2.49

SUMMARY

GREAT WEST COAL COMPANY LIMITED, EDMONTON, ALBERTA

Capital

Issued—Common	$ 127,500
Consideration for issue of Capital—Properties	$ 127,500

	1930	1944
Properties—Net Valuation	$ 5,564	$ 44,319
Net Current Position	131,972	99,587
Surplus	15,540	15,484

Earnings Record

Profits—15 years

(a) Before Income Tax	$ 71,902
(b) After Income Tax	55,923

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ 8,613	$ 12,581	$ *641*	$ 901
(b) After Income Tax	7,250	10,909	*641*	856

Dividend Record

Total Dividends Paid—15 Years ....$ 44,917

Rate on Capital—2.88 per cent for 4 years; 3.84 per cent for 2 years and 16 per cent for 1 year.

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 62,137
Total Depletion (15 years) charged to Operations	Nil

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

Production Subsidies	$ 44,841

Total Paid to March 31, 1946

Production Subsidies	$ 99,899

Production Record

Total Tonnage—15 years ....1,131,658 tons

	1930	1935	1939	1944
Annual Production (tons)	85,974	82,048	63,071	66,399
Per Man-Day Production (tons)	—	—	3.3	2.9
Sales Realization—per ton	$ 2.58	$ 1.92	$2.03	$ 3.05
Total Cost—per ton	2.57	1.87	2.15	3.79

SUMMARY

KENT COAL COMPANY LIMITED, EDMONTON, ALBERTA

Incorporated 1934

Capital			
Issued—Common	$ 16,006		
Consideration for issue of			
Capital—Cash	$ 6,000		
Properties	10,006		

	1935	1944
Properties—Net Valuation	$ 47,623	$ 28,940
Net Current Position	*3,445*	3,496
Deficit	*472*	*7,323*

Earnings Record

Losses—10 years

(a) Before Income Tax	$ *5,999*
(b) After Income Tax	*6,398*

Annual *Loss*	1935	1939	1944
(a) Before Income Tax	$ *472*	$ *555*	$ *5,045*
(b) After Income Tax	*472*	*555*	*5,444*

Dividend Record

Total Dividends Paid—10 years	Nil

Depreciation and Depletion

Total Depreciation (10 years) charged to Operations	$ 25,825
Total Depletion (10 years) charged to Operations	Nil

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

Production Subsidies (Receivable $4,764)	$ 50,726

Total Paid to March 31, 1946

Production Subsidies	$ 93,110

Production Record

Total Tonnage—10 years	604,504 tons

	1935	1939	1944
Annual Production (tons)	55,020	66,013	47,981
Sales Realization—per ton	$ 1.87	$ 1.71	$ 2.88
Total Cost—per ton	1.91	1.77	3.92

SUMMARY

LAKESIDE COALS LIMITED, EDMONTON, ALBERTA

Incorporated 1917

Capital

Issued—Common	$ 634,276
Consideration for issue of Capital—Cash / Properties	$ 634,276

	1930	1944
Properties—Net Valuation	$ 540,200	$ 452,685
Net Current Position	*15,040*	15,851
Surplus or *Deficit*	40,211	*161,507*

Earnings Record

Losses—15 years

(a) Before Income Tax	$ *99,022*
(b) After Income Tax	*99,682*

Annual *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ *395*	$ *4*	$ *14,736*	$ *5,816*
(b) After Income Tax	*395*	*4*	*14,736*	*6,476*

Dividend Record

Total Dividends Paid—15 years	Nil

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 160,076
Total Depletion (15 years) charged to Operations	125,019

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

(a) Production Subsidies (Receivable $35,616)	$ 29,670
(b) Loans	27,650

Total Paid to March 31, 1946

(a) Production Subsidies	$ 117,802
(b) Loans	13,825

Production Record

Total Tonnage—15 Years	1,250,190 tons

	1930	1935	1939	1944
Annual Production (tons)	69,686	64,734	58,175	126,156
Per Man-Day Production (tons)—				
Wabamun Mine	—	4.65	4.05	3.51
Robb Mine	—	3.10	3.15	2.41
Sales Realization—per ton	$ 2.70	$ 2.30	$ 2.30	$ 3.66
Total Cost—per ton	2.75	2.41	2.65	4.39

SUMMARY

RED FLAME COAL COMPANY LIMITED, CAMROSE, ALBERTA

Incorporated 1940

Capital		
Authorized—Common	$ 20,000	
Issued—Common	$ 13,500	
Consideration for issue of		
Capital—Cash	$ 4,502	
Properties	8,998	
		1944
Properties—Net Valuation		$ 9,015
Net Current Position		1,168
Deficit		*1,519*
Earnings Record		
Profits—4 Years		
(a) Before Income Tax (after Subsidy Adjustment)	$ 10,381	
(b) After Income Tax (after Subsidy Adjustment)	5,247	
Annual Profit or *Loss*		1944
(a) Before Income Tax		$ *646*
(b) After Income Tax		*646*
Dividend Record		
Total Dividends Paid—4 years	$ 2,700	
Rate on Capital—20 per cent for one year.		
Depreciation and Depletion		
Total Depreciation (4 years) charged to Operations	$ 10,833	
Total Depletion (4 years) charged to Operations	11,436	
Assistance—Emergency Coal Production Board		
Included in Accounts to 1944		
Production Subsidies (Receivable $2,966)	$ 2,082	
Total Paid to March 31, 1946		
(a) Production Subsidies	$ 35,480	
(b) Loan	5,329	
Production Record		
Total Tonnage—4 years	109,985 tons	
		1944
Annual Production (tons)		33,030
Per Man-Day Production (tons)		2.9
Sales Realization—per ton		$ 3.02
Total Cost—per ton		3.15

STRIPPING MINES OPERATING IN ALBERTA

PRIVATELY FINANCED

	Production
Black Nugget Coal Company Limited (2 years)	80,921 tons
Coal Valley Mining Company Limited (15 years)	2,044,790 tons
Dodds Coal Mine (2 years)	61,498 tons
Sheerness Coal Company Limited (8 years)	181,046 tons
Sterling Collieries Company Limited (15 years)	1,905,306 tons
Tofield Coal Company Limited (15 years)	864,597 tons
	5,138,158 tons

The following balance sheet shows the financial position of the companies as at the end of their fiscal periods in 1944 and 1945.

Assets—	
Properties	$ 3,017,410.23
Less reserve for depletion and depreciation	1,354,979.49
Net Properties	1,662,430.74
Deferred	142,990.13
Net current position	540,181.81
	2,345,602.68
Liabilities—	
Share capital	$ 1,619,000.00
Reserves	4,070.87
Surplus—Earned	216,159.86
Capital	170,019.08
Due to shareholders	295,671.67
Funded debt	40,681.20
	2,345,602.68

During the fifteen-year period reviewed, the following dividends have been paid:

Company	*Amount*
Coal Valley Mining Company Limited	$ 200,000.00
Sterling Collieries Company Limited	80,000.00
Tofield Coal Company Limited	16,000.00

SUMMARY OF OPERATING RESULTS—1930 TO 1945

	1930 to 1942		1943 to 1945		Total	
	Amount	Per Ton	Amount	Per Ton	Amount	Per Ton
	tons		tons		tons	
Tonnage Sold	4,076,235	....	981,002	....	5,057,237	
	$	$	$	$	$	$
Realization	8,802,166.84	2.159	2,260,523.54	2.304	11,062,690.38	2.187
Deduct Costs						
Stripping	1,528,085.39	0.375	569,122.79	0.580	2,097,208.18	0.415
Labour	2,409,057.53	0.591	679,445.16	0.693	3,088,502.69	0.611
Material	895,102.75	0.220	175,649.36	0.179	1,070,752.11	0.212
Power	557,433.99	0.137	103,892.60	0.106	661,326.59	0.131
Taxes and Rentals	153,095.69	0.037	38,029.54	0.039	191,125.23	0.038
Royalties	173,916.75	0.043	40,930.38	0.042	214,847.13	0.042
Workmen's Compensation Board	115,730.96	0.028	34,526.83	0.035	150,257.79	0.030
Other Costs	345,321.93	0.085	75,360.93	0.077	420,682.86	0.083
Administration and Overhead	1,321,779.23	0.324	251,736.07	0.257	1,573,515.30	0.311
	7,499,524.22	1.840	1,968,693.66	2.008	9,468,217.88	1.873
Depreciation	496,343.94	0.122	78,308.93	0.080	574,652.87	0.114
Depletion	519,124.72	0.127	121,835.67	0.124	640,960.39	0.127
Development	131,318.24	0.032	3,607.40	0.004	134,925.64	0.027
Total Costs	8,646,311.12	2.121	2,172,445.66	2.216	10,818,756.78	2.141
Net Profit on Stripping	155,855.72	0.038	88,077.88	0.088	243,933.60	0.046
Add Sundry Revenue	433,894.35	0.106	81,883.61	0.084	515,777.96	0.102
Net Profit, before Taxes	589,750.07	0.144	169,961.49	0.172	759,711.56	0.148
Deduct Income Taxes	246,195.46	0.061	83,432.29	0.085	329,627.75	0.065
Net Profit	343,554.61	0.083	86,529.20	0.087	430,083.81	0.083

In the later years the Sterling Company reduced its capital by $500,000 and the Tofield Company by $150,000, or a total of $650,000, part of which is shown as amounts due to shareholders.

On the previous page is a statement of the operating results of these stripping mines. It shows that they have made a net profit after taxes of 8.3 cents per ton over the fifteen-year period after including a charge for depletion of 12.7 cents. During the period 1943 to 1945 the net profit on stripping operations was 8.8 cents per ton, compared with 3.8 cents per ton in the period 1930-1942.

Government Assistance

The only financial assistance received was a loan of $2,029.34 to the Black Nugget Company, which was outstanding at March 31, 1946. No production subsidies have been paid to any of these stripping companies.

SUMMARY

BLACK NUGGET COAL COMPANY LIMITED, CAMROSE, ALBERTA

Incorporated 1944

Capital		
Issued—Common	$ 12,000	
Consideration for issue of Capital—Cash	$ 12,000	
		1946
Properties—Net Valuation		$ 74,660
Net Current Position		3,456
Deficit		*10,291*
Earnings Record		
Losses—2 years		
(a) Before Income Tax	$ *10,291*	
Annual *Loss*	1945	1946
(a) Before Income Tax	$ *6,622*	$ *3,668*
Dividend Record		
Total Dividends Paid—2 years	Nil	
Depreciation and Depletion		
Total Depreciation (2 years) charged to Operations		$ 12,566
Total Depletion (2 years) charged to Operations		8,092
Assistance—Emergency Coal Production Board		
Included in Accounts to 1944		
Production Subsidies		Nil
Total Paid to March 31, 1946		
(a) Production Subsidies		Nil
(b) Loan		$ 2,029
Production Record		
Total Tonnage—2 years	80,921 tons	
	1945	1946
Annual Production (tons)	17,339	63,582
Sales Realization—per ton	$ 2.20	$ 2.11
Total Cost—per ton	2.60	2.18

SUMMARY

COAL VALLEY MINING COMPANY LIMITED, COALSPUR, ALBERTA

Capital

Issued—Common	$1,000,000	
	1930	1944
Properties—Net Valuation	$1,131,500	$ 896,149
Net Current Position	15,129	285,411
Surplus	98,066	169,824

Earnings Record

Profits—15 years

(a) Before Income Tax	$ 384,025
(b) After Income Tax	266,812

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ 4,891	$ 24,408	$ 14,934	$ *2,716*
(b) After Income Tax	4,806	16,927	11,352	*2,716*

Dividend Record

Total Dividends Paid—15 years .... $ 200,000

Rate on Capital—1 per cent for 3 years, 2 per cent for 4 years.
3 per cent for 1 year, and 6 per cent for 1 year.

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 269,908
Total Depletion (15 years) charged to Operations	162,756

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

Production Subsidies .... Nil

Total Paid to March 31, 1946 Production Subsidies .... Nil

Production Record

Total Tonnage—15 years .... 2,044,790 tons

	1930	1935	1939	1944
Annual Production (tons)	121,446	124,850	112,072	132,247
Per Man-Day Production (tons)	3.6	4.3	5.6	5.3
Sales Realization—per ton	$ 2.44	$ 2.22	$ 2.22	$ 2.79
Total Cost—per ton	2.51	2.21	2.22	3.09

SUMMARY

DODDS COAL MINE, DODDS, ALBERTA

Commenced 1944

PROPRIETORSHIP

		1945
Properties—Net Valuation		$ 18,171
Net Current Position		*7,476*
Proprietor's Capital		11,695
Earnings Record		
Profits—2 years		
(a) Before Income Tax	$ 7,718	
	1944	1945
Annual Profit	$ 3,957	$ 3,761
Dividend Record		
Total Dividends Paid—2 years	Nil	
Depreciation and Depletion		
Total Depreciation (2 years) charged to Operations	$ 4,280	
Total Depletion (2 years) charged to Operations	6,150	
Assistance—Emergency Coal Production Board		
Included in Accounts to 1944		
Production Subsidies	Nil	
Total Paid to March 31, 1946		
Production Subsidies	Nil	
Production Record		
Total Tonnage—2 years	61,498 tons	
	1944	1945
Annual Production (tons)	27,101	34,397
Sales Realization—per ton	$ 2.13	$ 2.09
Total Cost—per ton	1.98	1.98

SUMMARY

SHEERNESS COAL COMPANY LIMITED, SHEERNESS, ALBERTA

Incorporated 1937

Capital		
Authorized—Common	$ 10,000	
Issued—Common	$ 3,000	
Consideration for issue of		
Capital—Cash	$ 3,000	
	1938	1944
Properties—Net Valuation	$ —	$ 23,973
Net Current Position	2,567	11,797
Surplus or *Deficit*	—	7,870
Earnings Record		
Profits or *Losses*—8 years		
(a) Before Income Tax	$ 12,091	
(b) After Income Tax	7,305	

SUMMARY

SHERNESS COAL COMPANY LIMITED, SHERNESS, ALBERTA—*Concluded*

	1939	1944
Annual Profit or *Loss*		
(a) Before Income Tax	$ *347*	$ 4,840
(b) After Income Tax	*363*	2,904

Dividend Record
Total Dividends Paid—8 years.......... Nil

Depreciation and Depletion
Total Depreciation (8 years) charged to Operations..........$ 11,131
Total Depletion (8 years) charged to Operations.......... 16,419

Assistance—Emergency Coal Production Board
Included in Accounts to 1944
Production Subsidies.......... Nil

Total Paid to March 31, 1946
Production Subsidies.......... Nil

Production Record
Total Tonnage—8 years.......... 181,046 tons

	1939	1944
Annual Production (tons)	8,178	47,149
Per Man-Day Production (tons)	4.0	14.6
Sales Realization—per ton	$ 1.44	$ 1.65
Total Cost—per ton	1.49	1.55

SUMMARY

STERLING COLLIERIES LIMITED, STERCO, ALBERTA

Incorporated 1926

Capital
Issued—Common..........$1,000,000

Consideration for issue of
Capital—Cash / Properties..........$1,000,000

	1930	1944
Properties—Net Valuation	$1,143,898	$ 587,697
Net Current Position	57,771	183,136
Surplus or *Deficit*	*163,736*	23,307

Earnings Record
Profits—15 years
(a) Before Income Tax..........$ 323,996
(b) After Income Tax.......... 127,497

Annual Profit	1930	1935	1939	1944
(a) Before Income Tax	$ 8,120	$ 7,252	$ 53,795	$ 20,899
(b) After Income Tax	8,120	5,917	39,448	12,565

Dividend Record
Total Dividends Paid—15 years..........$ 80,000
Rate on Capital—1 per cent for 2 years and 2 per cent for 3 years.

Depreciation and Depletion
Total Depreciation (15 years) charged to Operations..........$ 205,053
Total Depletion (15 years) charged to Operations.......... 343,780

SUMMARY

STERLING COLLIERIES LIMITED, STERCO, ALBERTA—*Concluded*

Assistance—Emergency Coal Production Board
Included in Accounts to 1944
Production Subsidies.. Nil

Total Paid to March 31, 1946
Production Subsidies.. Nil

Production Record
Total Tonnage—15 years..1,905,306 tons

	1930	1935	1939	1944
Annual Production (tons)............	133,733	123,119	109,935	135,270
Sales Realization—per ton...........	$ 2.36	$ 2.25	$ 2.23	$ 2.77
Total Cost—per ton..................	2.44	2.32	1.81	2.68

SUMMARY

TOFIELD COAL COMPANY LIMITED, TOFIELD, ALBERTA

Capital
Issued—Common..$ 250,000 reduced to $100,000

Consideration for issue of
Capital—Cash / Properties..$ 250,000

	1931	1945
Properties—Net Valuation..$	151,357	$ 60,780
Net Current Position..	106,800	68,327
Surplus..	13,156	17,755

Earnings Record
Profits—15 years
(*a*) Before Income Tax..$ 31,882
(*b*) After Income Tax.. 20,770

Annual Profit or *Loss*	1931	1935	1939	1945
(*a*) Before Income Tax.............	$ 5,170	$ *9,385*	$ *795*	$ 7,408
(*b*) After Income Tax..............	5,170	*9,502*	*795*	5,949

Dividend Record
Total Dividends Paid—15 years..$ 16,000
Rate on Capital—2 per cent for 2 years and 4 per cent for 1 year.

Depreciation and Depletion
Total Depreciation (15 years) charged to Operations.............$ 84,280
Total Depletion (15 years) charged to Operations............... 111,855

Assistance—Emergency Coal Production Board
Included in Accounts to 1944
Production Subsidies.. Nil

Total Paid to March 31, 1946
Production Subsidies.. Nil

Production Record
Total Tonnage—15 years.. 864,597 tons

	1931	1935	1939	1945
Annual Production (tons)............	89,099	54,804	41,473	58,315
Sales Realization—per ton...........	$ 1.76	$ 1.45	$ 1.29	$ 1.94
Total Cost—per ton..................	1.72	1.69	1.32	1.82

COMPANIES OPERATING AS AN EMERGENCY WAR MEASURE AND FINANCED BY THE EMERGENCY COAL PRODUCTION BOARD

	Production
Birnwel Coal Limited (1943-1946)	352,093 tons
Camrose Collieries Limited (1943-1946)	99,702 tons
Castor Creek Collieries Ltd. (1943-1946)	53,498 tons
Continental Coal Corp. Ltd. (1944-1946)	173,445 tons
Western Ventures Limited (1944-1946)	127,086 tons
Majestic Mines Limited (1943-1946)	38,106 tons
	843,930 tons

The above companies were formed during the war years as an emergency measure to obtain coal at any cost to aid the Canadian war effort. Production of 844,000 tons was obtained from these stripping operations from date of inception to the closing dates in 1946.

A final statement of affairs of these companies is shown by the following balance sheet made up to the end of the closing of their fiscal periods in 1946.

Assets			
Plant and equipment—cost			$ 751,186.17
Current assets		$ 49,690.17	
Less current liabilities		32,228.47	
			17,461.70
			$ 768,647.87
Liabilities			
Emergency Coal Production Board			$1,417,211.03
Share capital		$ 87,852.00	
Less issued for leases or unpaid		75,300.00	
			12,552.00
Deficit		$ *682,245.67*	
Add deferred assets		10,722.59	
deferred stripping		10,496.10	
		$ *703,464.36*	
Less depreciation reserve	$ 19,304.00		
depletion reserve	23,045.20		
		42,349.20	
			661,115.16
			$ 768,647.87

Government Assistance

As mentioned previously, these companies were financed by the Dominion Government, and to March 31, 1946, the following amounts were unpaid, according to the records of the Emergency Coal Production Board:

	Loans
Camrose Collieries Limited	$ 335,808.92
Castor Creek Collieries Limited	185,425.15
Birnwel Coal Company Limited	152,701.28
Majestic Mines Limited	189,033.53
Western Ventures Limited	353,572.52
Continental Coal Company	504,553.27
	$ 1,721,094.67

The liability as shown by the statements of the various companies at the end of the 1946 fiscal periods was $1,417,211.03, the difference of approximately $304,000 representing cash payments and various adjustments still to be finalized by the Board.

Very little recovery of these loans is anticipated. According to the agreement, the plant and equipment is the property of the company when the capital loans have been repaid. As most of the capital loans have been repaid, the operating loans are unsecured and, therefore, are not deemed to be recoverable.

A statement follows, summarizing the result of the operations of these companies from date of inception to closing dates in 1946. A net loss of 91 cents per ton is shown after depreciation and depletion charges of 5.4 cents.

—	Amount	Per Ton
Tons sold	817,414	
	$	$
Realization	3,020,846.86	3.696
Deduct costs		
Stripping costs including labour, material, power, haulage, tipple operations, Workmen's Compensation Board, etc	3,173,435.93	3.882
Taxes and rentals	22,714.14	0.028
Royalties	97,980.48	0.120
Administration and Overhead	453,689.11	0.555
	3,747,819.66	4.585
Depreciation	22,488.81	0.027
Depletion	22,270.80	0.027
Total cost	3,792,579.27	4.639
Loss on stripping operations	771,732.41	0.943
Deduct sundry revenue	27,005.07	0.033
Net *loss*	744,727.34	0.910

If the liability of $1,417,211.03 to the Emergency Board were regarded as a further loss, the per-ton loss would be increased by $1.73 or a total per-ton loss of $2.64.

A short review of the "Government-sponsored Strip Mines in Alberta," dealing with the need for this project, is given in the chapter "Government in Relation to the Coal Industry."

OTHER COMPANIES OPERATING IN ALBERTA

Alexo Coal Company Limited, Alexo, Alta.

Big Horn and Saunders Creek Collieries Limited, Saunders Creek, Alta.

Foothills Collieries Limited, Foothills, Alta.

Lethbridge Collieries Limited, Lethbridge, Alta.

As the above four companies operate in widely separated areas which present many different physical aspects, they are not capable of being grouped either with each other or with other fields and consequently are dealt with individually.

Their history, financial position, operating results, et cetera, now follow.

ALEXO COAL COMPANY LIMITED

Alexo, Alberta

Alexo Coal Company Limited has operated for many years in the Saunders district in Central Alberta, with a total production over the years reviewed of 334,778 tons.

Authorized share capital is $200,000, of which there is issued $125,900. Of the issued capital, $103,700 was for a cash consideration and $22,200 for leases.

Bonds at 6 per cent were issued in 1930 in partial settlement of loans and accrued interest to the amount of $59,400. As at March 31, 1944, no principal had been paid on these thirty-year sinking fund debentures nor cash provided for a sinking fund. Additional loans from shareholders were outstanding at the same date totalling $19,949.67.

Bond interest was paid only for the year 1931. For the years 1932-1940 the interest was waived by the holders, and the outstanding interest in 1944 represents four years' (1941-1944) accumulation at 6 per cent simple interest in the amount of $14,256.

The comparative financial position of the company is shown by the following balance sheets as at March 31, 1930 and 1944.

—	1930	1944
	$	$
Assets—		
Net property value	272,951.41	243,025.11
Net current position	60,187.82	*13,660.21*
	333,139.23	229,364.90
Liabilities—		
Share capital	125,900.00	125,900.00
Funded debt, with accrued interest and loans from shareholders	59,400.00	93,605.67
Surplus	147,839.23	9,859.23
	333,139.23	229,364.90

ALEXO COAL COMPANY LIMITED, ALEXO, ALBERTA

SUMMARY OF OPERATIONS—1930 TO 1944

—	1930 to 1935			1936 to 1939			1940 to 1944			Totals		
	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton
		Tons			Tons			Tons			Tons	
Tonnage	....	147,160	....	....	78,917	....	....	108,701	....	....	334,778	....
		$	$		$	$		$	$		$	$
Realization	....	582,412.73	3.958	....	289,393.12	3.667	....	486,146.73	4.473	....	1,357,952.58	4.056
Deduct Costs												
Labour				59.232	211,424.39	2.679	60.569	351,491.97	3.234	62.528	1,025,934.59	3.065
Material	65.820	463,018.23	3.146	6.324	22,572.41	0.286	5.497	31,897.85	0.294	3.320	54,470.26	0.163
Power				0.770	2,750.00	0.035	2.608	15,134.00	0.139	1.090	17,884.00	0.053
Repairs and Maintenance	1.610	11,324.11	0.077	1.173	4,187.18	0.053	1.921	11,149.81	0.103	1.625	26,661.10	0.080
Workmen's Compensation Board	2.546	17,908.62	0.122	3.311	11,817.22	0.150	5.231	30,354.11	0.279	3.662	60,079.95	0.179
Insurance and Taxes	2.057	14,468.49	0.098	2.191	7,819.16	0.099	1.821	10,567.88	0.097	2.003	32,855.53	0.098
Royalties	1.024	7,200.10	0.049	0.953	3,402.65	0.043	0.866	5,025.45	0.046	0.953	15,628.20	0.047
Rentals	1.651	11,612.74	0.079	1.358	4,848.14	0.061	0.802	4,651.73	0.043	1.287	21,112.61	0.063
Development	0.455	3,205.33	0.022	....	....	....	1.019	5,910.76	0.054	0.556	9,115.09	0.027
Selling Expense	6.482	45,599.10	0.310	6.899	24,625.86	0.312	4.724	27,417.47	0.252	5.951	97,642.43	0.292
Administration	8.331	58,604.43	0.398	10.465	37,353.10	0.473	9.056	52,556.16	0.084	9.052	148,513.69	0.444
	89.976	632,940.15	4.301	92.676	330,800.11	4.191	94.114	546,157.19	5.025	92.027	1,509,897.45	4.511
Depreciation	7.933	55,807.19	0.379	5.113	18,251.84	0.232	4.013	23,289.74	0.214	5.933	97,348.77	0.290
Depletion	2.091	14,716.00	0.100	2.211	7,892.36	0.100	1.873	10,870.50	0.100	2.040	33,478,86	0.100
Total Costs	100.000	703,463.34	4.780	100.000	356,944.31	4.523	100.000	580,317.43	5.339	100.000	1,640,725.08	4.901
Profit or *Loss* on Operations	....	*121,050.61*	*0.822*	....	*67,551.19*	*0.856*	....	*94,170.70*	*0.866*	....	*282,772.50*	*0.845*
Bond Interest	....	3,564.00	0.024	....	....	....	....	14,256.00	0.131	....	17,820.00	0.053
Profit or *Loss*	....	*124,614.61*	*0.846*	....	*67,551.19*	*0.856*	....	*108,426.70*	*0.997*	....	*300,592.50*	*0.898*
Sundry Revenue	....	57,826.68	0.393	....	26,512.36	0.336	....	23,190.90	0.213	....	107,529.94	0.321
Subsidies	....	....	....	....	....	....	....	65,731.73	0.605	....	65,731.73	0.196
Profit or *Loss*, before Income Tax	....	*66,787.93*	*0.453*	....	*41,038.83*	*0.520*	....	*19,504.07*	*0.179*	....	*127,330.83*	*0.381*
Income Taxes	....	1,762.58	0.012	....	....	....	....	1,370.06	0.012	....	3,132.64	0.009
Profit or *Loss*	....	*68,550.51*	*0.465*	....	*41,038.83*	*0.520*	....	*20,874.13*	*0.191*	....	*130,463.47*	*0.390*

Additions to property over the terms of years reviewed amounted to $80,000.

Dividends at 3 per cent were paid in the years 1930 and 1931.

Operating Results

On the facing page, the summary of operations over the fifteen years shows a total loss of 39 cents per ton, which is exactly the amount per ton for depreciation and depletion.

Subsidies were received by Alexo for the years 1943 and 1944 at the rate of 92 cents and $1.94 per ton, respectively, for a total amount of $65,731.73. Total production subsidies to March 31, 1946, amounted to $92,773.01.

Using representative years, an analysis of the profit and loss account (per ton) follows:

—	1930	1935	1939	1944
Tonnage	40,688	18,904	17,621	22,410
	$	$	$	$
Sales	4.427	3.449	3.927	4.846
Sundry Revenue	0.214	0.364	0.453	0.239
Subsidy	....	....	....	1.939
	4.641	3.813	4.380	7.024
Deduct				
Labour, material, etc	3.115	2.971	3.379	4.944
General charges	0.357	0.397	0.409	0.729
Depreciation and depletion	0.661	0.340	0.356	0.316
Selling and administration expense	0.442	0.701	0.600	0.748
Bond interest	....	....	....	0.159
	4.575	4.409	4.744	6.896
Profit *or loss*	0.066	*0.596*	*0.364*	0.128

Production per man-day for the years 1943 and 1944 was 1.80 tons.

SUMMARY

ALEXO COAL COMPANY LIMITED, ALEXO, ALBERTA

Capital		
Authorized—Common	$ 200,000	
Issued—Common	$ 125,900	
Consideration for issue of		
Capital—Cash	$ 103,700	
Properties	22,200	
	1930	**1944**
Properties—Net Valuation	$ 272,951	$ 243,025
Net Current Position	60,187	*13,660*
Surplus	147,839	9,859

Earnings Record

Losses—15 years

(a) Before Income Tax	$ *127,330*
(b) After Income Tax	*130,463*

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ 2,675	$ *14,853*	$ *9,941*	$ 2,860
(b) After Income Tax	2,675	*14,853*	*9,941*	1,490

Dividend Record

Total Dividends Paid—15 years ..... $ 7,551

Rate on Capital—3 per cent for 1930 and 1931.

Depreciation and Depletion

Total Depreciation (15 years) charged to Operations	$ 97,349
Total Depletion (15 years) charged to Operations	33,479

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

Production Subsidies ..... $ 65,732

Total Paid to March 31, 1946

Production Subsidies ..... $ 92,773

Production Record

Total Tonnage—15 years ..... 334,778 tons

	1930	1935	1939	1944
Annual Production (tons)	40,688	18,904	17,621	22,410
Per Man-Day Production (tons)	—	—	—	1.80
Sales Realization—per ton	$ 4.43	$ 3.45	$ 3.93	$ 4.85
Total Cost—per ton	4.57	4.41	4.74	6.90

BIG HORN AND SAUNDERS CREEK COLLIERIES LIMITED, SAUNDERS CREEK, ALBERTA

STATEMENT OF OPERATIONS—1930 to 1944

—	1930 to 1935			1936 to 1939			1940 to 1944			Totals		
	Per-centage of Cost	Amount	Amount per Ton	Per-centage of Cost	Amount	Amount per Ton	Per-centage of Cost	Amount	Amount per Ton	Per-centage of Cost	Amount	Amount per Ton
		Tons			Tons			Tons			Tons	
Tonnage	....	114,094	....	....	87,909	....	....	174,893	....	....	376,896	....
		$	$		$	$		$	$		$	$
Realization	....	442,494.58	3.878	....	310,552.61	3.533	....	761,619.57	4.355	....	1,514,666.76	4.019
Sundry Revenue	....	42,801.14	0.375	....	29,277.80	0.333	....	45,970.35	0.263	....	118,049.29	0.313
	....	485,295.73	4.253	....	339,830.41	3.866	....	807,589.92	4.618	....	1,632,716.05	4.332
Deduct Costs												
Labor	56.136	294,211.94	2.579	54.261	213,207.41	2.425	60.798	504,167.44	2.883	57.928	1,011,586.79	2.684
Material	7.895	41,376.18	0.363	6.314	24,811.40	0.282	7.375	61,154.12	0.350	7.292	127,341.70	0.338
Power	7.423	38,906.90	0.341	7.897	31,028.00	0.353	10.167	84,313.38	0.482	8.833	154,248.28	0.409
Royalties	0.982	5,145.55	0.045	1.005	3,946.76	0.045	0.925	7,669.47	0.044	0.960	16,761.78	0.044
Workmen's Compensation Board	2.497	13,088.13	0.115	3.375	13,263.27	0.151	6.022	49,937.49	0.286	4.369	76,288.89	0.202
Insurance	1.377	7,218.92	0.063	0.698	2,743.63	0.031	0.288	2,388.91	0.014	0.707	12,351.46	0.033
Taxes and Rentals	2.828	14,821.63	0.130	2.228	8,756.48	0.100	1.587	13,160.22	0.075	2.104	36,738.33	0.097
Selling Expenses	2.077	10,884.34	0.095	2.144	8,423.62	0.096	1.092	9,053.89	0.052	1.624	28,361.85	0.075
Administration	6.409	33,591.11	0.294	7.232	28,416.45	0.323	4.669	38,716.42	0.221	5.768	100,723.98	0.267
	87.624	459,244.70	4.025	85.154	334,597.02	3.806	92.923	770,561.34	4.407	89.585	1,564,403.06	4.149
Depreciation	10.198	53,448.23	0.468	12.608	49,542.14	0.564	4.968	41,197.71	0.235	8.257	144,188.08	0.383
Depletion	2.178	11,414.46	0.100	2.238	8,790.98	0.100	2.109	17,489.40	0.100	2.158	37,694.84	0.100
	100.000	524,107.39	4.593	100.000	392,930.14	4.470	100.000	829,248.45	4.742	100.000	1,746,285.98	4.632
Profit or *Loss* on Operations	....	*38,811.67*	*0.340*	....	*53,099.73*	*0.604*	....	*21,658.53*	*0.124*	....	*113,569.93*	*0.300*
Bond and General Interest	....	199,650.39	1.750	....	16,727.57	0.190	....	21,324.66	0.122	....	237,702.62	0.631
Profit or *Loss*	....	*238,462.06*	*2.090*	....	*69,827.30*	*0.794*	....	*42,983.19*	*0.246*	....	*351,272.55*	*0.931*
Subsidy	....	....	....	....	....	....	....	12,374.69	0.071	....	12,374.69	0.033
Net Profit or *Loss*	....	*238,462.06*	*2.090*	....	*69,827.30*	*0.794*	....	*30,608.50*	*0.175*	....	*338,897.86*	*0.898*

BIG HORN AND SAUNDERS CREEK COLLIERIES LIMITED

Saunders Creek, Alberta

This company operates in the Saunders Creek area of Central Alberta, and has produced 376,896 tons of coal over the fifteen-year period.

Share capital has been issued of $228,200, and 8 per cent bonds in the amount of $200,000 were exchanged for coal properties.

With the exception of the sum of $4,000 paid in the year 1943 and $8,000 paid in 1944 and representing interest at 2 per cent on the outstanding bonds, the interest on the bonds has not been paid and has accumulated to the undernoted figure in 1944.

The undernoted balance sheet shows the financial position of the company in 1930 and 1944.

—	1930	1944
	$	$
Assets—		
Net properties	476,682.63	196,799.87
Deferred	1,215.47	1,732.12
Net current position	33,412.09	41,939.29
	511,310.19	240,471.28
Liabilities—		
Capital	228,200.00	228,200.00
Funded debt	200,000.00	200,000.00
Accrued interest on funded debt	207,753.13	243,772.60
Deficit	*124,642.94*	*431,501.32*
	511,310.19	240,471.28

On the previous page is a statement of the operations over the fifteen years. Before making provision for depletion, depreciation and bond interest, the company shows a profit of 18 cents per ton. After the above named charges are included, a per-ton loss of 90 cents results.

The company manages to keep operating as depreciation and depletion are non-cash items and, as mentioned previously, the bond interest has not been paid. Approximately $18,000 has been added to plant during the period.

Government Assistance

Production subsidy to the amount of $25,163.77 was received to March 31, 1946. Of this amount, the sum of $12,374.69 was in respect of the year 1944 and represented 32 cents per ton.

For the years as shown a summary of the profit and loss account per ton and the production per man-day is as follows:

—	1930	1935	1939	1944
Tonnage	27,900	20,311	22,113	38,283
	$	$	$	$
Sales	4.237	3.60	3.499	5.023
Sundry revenue	0.317	0.37	0.344	0.257
Subsidy	....	....	....	0.323
	4.554	3.97	3.843	5.603
Mining cost	3.687	2.89	3.181	4.473
General charges	0.140	0.17	0.195	0.430
Depreciation and depletion	0.300	0.70	0.665	0.180
Administration	1.343	0.63	0.547	0.340
	....	0.64	0.190	0.122
	5.470	5.03	4.778	5.545
Profit or *loss*	*0.916*	*1.06*	*0.935*	0.058
Tons produced per man-day	3.450	1.90	2.420	2.160

SUMMARY

BIG HORN AND SAUNDERS CREEK COLLIERIES LIMITED, SAUNDERS, ALBERTA

Capital		
Issued—Common	$ 228,200	
Consideration for issue of Capital—Cash / Properties	$ 228,200	
	1930	1944
Properties—Net Valuation	$ 476,683	$ 196,800
Net Current Position	33,412	41,939
Deficit	*124,643*	*431,501*
Earnings Record		
Losses—15 years		
(a) Before Income Tax	$ *338,897*	
(b) After Income Tax	*338,897*	

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ *25,848*	$ *21,575*	$ *20,683*	$ 2,241

Dividend Record	
Total Dividends Paid—15 years	Nil
Depreciation and Depletion	
Total Depreciation (15 years) charged to Operations	$ 144,188
Total Depletion (15 years) charged to Operations	37,695
Assistance—Emergency Coal Production Board	
Included in Accounts to 1944 Production Subsidies	$ 12,375
Total Paid to March 31, 1946 Production Subsidies	$ 25,164
Production Record	
Total Tonnage—15 years	376,896 tons

	1930	1935	1939	1944
Annual Production (tons)	27,900	20,311	22,113	38,283
Per Man-Day Production (tons)	3.45	1.90	2.42	2.16
Sales Realization—per ton	$ 4.24	$ 3.60	$ 3.50	$ 5.02
Total Cost—per ton	5.47	5.03	4.78	5.55

FOOTHILLS COLLIERIES LIMITED, FOOTHILLS, ALBERTA

STATEMENT OF OPERATIONS—1930 TO 1944

—	1930 to 1935			1936 to 1939			1940 to 1944			Totals		
	Per-centage of Cost	Amount	Amount per Ton	Per-centage of Cost	Amount	Amount per Ton	Per-centage of Cost	Amount	Amount per Ton	Per-centage of Cost	Amount	Amount per Ton
		Tons			Tons			Tons			Tons	
Tonnage	....	291,660	....	....	185,778	....	....	328,144	....	....	805,582	....
		$	$		$	$		$	$		$	$
Realization	....	997,016.12	3.418	....	540,823.42	2.911	....	1,022,938.49	3.118	....	2,560,778.03	3.179
Deduct Costs												
Underground	58.199	633,024.83	2.170	57.548	348,918.71	1.878	57.669	663,918.67	2.024	57.846	1,645,862.21	2.043
Surface	23.130	251,583.72	0.862	23.624	143,237.18	0.770	22.452	258,485.43	0.788	22.961	653,306.33	0.811
Insurance	1.437	15,630.93	0.054	1.903	11,538.71	0.062	1.372	15,794.36	0.048	1.510	42,964.00	0.053
Workmen's Compensation Board	2.657	28,896.03	0.099	3.522	21,355.10	0.115	5.301	61,029.06	0.186	3.911	111,280.19	0.138
Taxes, Rentals and Royalties	2.495	27,137.56	0.093	3.830	23,224.36	0.125	2.679	30,839.29	0.094	2.854	81,201.21	0.102
Administration and Overhead	4.258	46,310.13	0.159	4.985	30,225.27	0.163	4.159	47,882.48	0.146	4.373	124,417.88	0.154
	92.176	1,002,583.20	3.437	95.412	578,499.33	3.113	93.632	1,077,949.29	3.286	93.455	2,659,031.82	3.301
Depreciation	3.996	43,467.28	0.149	2.149	13,032.34	0.070	2.305	26,539.27	0.081	2.918	83,038.89	0.103
Depletion	2.963	32,234.42	0.110	2.223	13,479.00	0.073	2.198	25,302.37	0.077	2.496	71,015.79	0.088
Development	0.865	9,401.08	0.032	0.216	1,305.72	0.007	1.865	21,471.88	0.065	1.131	32,178.68	0.040
	100.000	1,087,685.98	3.728	100.000	606,316.39	3.263	100.000	1,151,262.81	3.509	100.000	2,845,265.18	3.532
Loss on Operations	....	*90,669.86*	*0.310*	....	*65,492.97*	*0.352*	....	*128,324.32*	*0.391*	....	*284,487.15*	*0.353*
Add Sundry Revenue	....	65,490.44	0.224	....	44,651.61	0.240	....	54,994.68	0.168	....	165,136.73	0.205
Subsidies	....	....	....	....	....	....	....	73,811.04	0.225	....	73,811.04	0.092
Net Profit or *Loss*	....	*25,179.42*	*0.086*	....	*20,841.36*	*0.112*	....	481.40	0.002	....	*45,539.38*	*0.056*

FOOTHILLS COLLIERIES LIMITED

Foothills, Alberta

This company operates in the Coalspur district of Northern Alberta, and has produced a total of 913,000 tons over the fifteen-year period.

Share capital has been issued of $190,700, on which there remains unpaid $4,130.

A comparison of the financial position in 1930 and 1944 is shown by the following balance sheet.

—	1930	1944
Assets—	$	$
Net property value	173,519.13	164,627.36
Deferred	870.50	4,993.85
Net current position—*deficiency*	*56,048.65*	*60,753.12*
	118,340.98	108,868.09
Liabilities—	$	$
Share capital	186,570.00	186,570.00
Deficit	*68,229.02*	*77,701.91*
	118,340.98	108,868.09

The deficiency in the current position in 1944 includes a loan from the Emergency Coal Production Board of $6,400 and $43,600 due on the purchase of mine leases, et cetera, including accrued interest.

Dividends have not been paid in any of the years from 1930-1944.

A summary of the operating results is shown on the facing page. An average loss of 5.6 cents per ton has been incurred after making provision for depreciation and development of 14.3 cents and 8.8 cents for depletion.

Man-day production varies from a low in 1934 of 2.56 tons to a high in 1944 of 3.83 tons.

Government Assistance

To March 31, 1946, this company received the sum of $152,606.55 from the Dominion Government, of which $146,170.43 represented production subsidies. The balance is carried as a loan from the Emergency Coal Production Board.

Up to 1944, production subsidies received totalled $73,811.04.

SUMMARY

FOOTHILLS COLLIERIES LIMITED, FOOTHILLS, ALBERTA

Capital
Issued—Common .... $ 186,570

Consideration for issue of
Capital—Cash / Properties .... $ 186,570

	1930	1944
Properties—Net Valuation	$ 173,519	$ 164,627
Net Current Position	*56,049*	*60,753*
Deficit	*68,229*	*77,702*

Earnings Record
Losses—15 years
(a) Before Income Tax .... $ *45,539*
(b) After Income Tax *49,977*

Annual Profit or *Loss*	1930	1935	1939	1944
(a) Before Income Tax	$ *6,833*	$ *2,511*	$ *1,570*	$ 4,985
(b) After Income Tax	*6,833*	*2,511*	*1,570*	2,885

Dividend Record
Total Dividends Paid—15 years .... Nil

Depreciation and Depletion
Total Depreciation (15 years) charged to Operations .... $ 83,039
Total Depletion (15 years) charged to Operations 71,016

Assistance—Emergency Coal Production Board
Included in Accounts to 1944
(a) Production Subsidies .... $ 73,811
(b) Loans 6,409

Total Paid to March 31, 1946
(a) Production Subsidies .... $ 146,170
(b) Loans 6,409

Production Record
Total Tonnage—15 years .... 913,065 tons

	1930	1935	1939	1944
Annual Production (tons)	69,048	56,617	46,432	117,203
Per Man-Day Production (tons)	2.77	2.77	2.80	3.83
Sales Realization—per ton	$ 3.71	$ 2.88	$ 3.08	$ 3.21
Total Cost—per ton	3.89	3.16	3.46	3.93

LETHBRIDGE COLLIERIES LIMITED

Lethbridge, Alberta

Lethbridge Collieries Limited was organized in 1935, taking over the properties of three predecessor companies.

The authorized and issued share capital consists of 60,000 A shares and 10,000 B shares, which had a par value of $10 each.

Of the capital, 60,000 of each of the A and B shares were issued for certain of the fixed assets and inventories of the predecessor companies, and the remaining 40,000 B shares were issued for a cash consideration of $400,000.

In October of 1941, the share capital was reduced by $200,000, representing a reduction in the par value of each class of shares to $8.75 per share. This reduction was in the form of a cash repayment of $84,800 to shareholders, and a writing-off of assets not in use of $68,214.71 and $46,985.29 of capital charges.

A comparison of the financial position of the company as at the end of the fiscal years in 1936 and 1944 is shown hereunder:

—	1936	1944
	$	$
Assets—		
Property values *less* reserves	1,441,254.99	1,015,983.73
Deferred	5,002.87	20,276.57
Net current position	223,298.87	507,353.61
	1,669,556.73	1,543,613.91
	$	$
Liabilities—		
Capital	1,600,000.00	1,400,000.00
Surplus	69,556.73	143,613.91
	1,669,556.73	1,543,613.91

Comparison of the fixed assets in 1936 and 1944 shows net property additions of $267,716.23.

During the period reviewed, total dividend payments were made of $306,000.

As is shown on the statement on page 246, profits before taxation totalled $536,033.01, or 20 cents per ton. After taxes of 5 cents per ton, the Company had net earnings of 15 cents. Depletion is not set up in the books of the company or included in the foregoing figures. By charging the usual allowance of 10 cents, the company would earn 5 cents per ton after depletion.

Using the undernoted representative years, the following are the costs and production per man-day:

—	1936	1939	1944
	$	$	$
Costs per ton	3.00	3.26	3.80
	Tons	Tons	Tons
Tons produced per man-day	3.48	3.27	3.46

Government Assistance

Up to March 31, 1944, the company had not received any subsidy assistance. Commencing April 1, 1944, and up to March 31, 1946, however, the sum of $128,204.84 had been paid by the Emergency Coal Production Board, representing $118,604.84 in production subsidy and $9,600 by way of a non-interest bearing loan.

LETHBRIDGE COLLIERIES LIMITED, LETHBRIDGE, ALBERTA

STATEMENT OF OPERATIONS—1936 TO 1944

—	1936 to 1939			1940 to 1944			Totals		
	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton
		Tons			Tons			Tons	
Tonnage	....	1,011,182	....	....	1,662,203	....	....	2,673,385	....
		$	$		$	$		$	$
Realization	....	3,144,495.16	3.110	....	5,810,255.29	3.495	....	8,954,750.45	3.350
Deduct Costs									
Labor	56.684	1,743,868.88	1.724	59.486	3,400,688.13	2.046	58.506	5,144,557.01	1.924
Material	11.191	344,284.98	0.341	11.415	652,592.31	0.393	11.337	996,877.29	0.373
Power	3.122	96,050.12	0.095	2.476	141,529.00	0.085	2.702	237,579.12	0.089
Royalties and Rentals	4.949	152,252.96	0.151	4.392	251,055.00	0.151	4.587	403,307.96	0.151
Workmen's Compensation Board	2.771	85,244.61	0.084	4.343	248,305.64	0.149	3.793	333,550.25	0.125
Insurance	0.393	12,087.23	0.012	0.308	17,618.93	0.011	0.338	29,706.16	0.011
Taxes and Rentals	1.111	34,180.38	0.034	0.973	55,640.67	0.033	1.021	89,821.05	0.033
Other Costs	0.842	25,917.89	0.026	0.823	47,045.50	0.028	0.830	72,963.39	0.027
Selling Expenses	4.596	141,380.89	0.140	2.477	141,622.18	0.085	3.218	283,003.07	0.106
Administration	5.269	162,111.91	0.160	3.762	215,056.76	0.130	4.289	377,168.67	0.142
	90.928	2,797,379.85	2.767	90.455	5,171,154.12	3.111	90.621	7,968,533.97	2.981
Depreciation	9.072	279,074.64	0.276	9.545	545,635.10	0.328	9.379	824,709.74	0.308
	100.000	3,076,454.49	3.043	100.000	5,716,789.22	3.439	100.000	8,793,243.71	3.289
Profit on Operations	....	68,040.67	0.067	....	93,466.07	0.056	....	161,506.74	0.061
Sundry Revenue	....	118,138.95	0.117	....	256,387.32	0.154	....	374,526.27	0.140
Profit before Taxes	....	186,179.62	0.184	....	349,853.39	0.210	....	536,033.01	0.201
Deduct Income Taxes	....	23,760.46	0.023	....	115,728.02	0.070	....	139,488.48	0.052
Net Profit	....	162,419.16	0.161	....	234,125.37	0.140	....	396,544.53	0.149

SUMMARY

LETHBRIDGE COLLIERIES LIMITED, LETHBRIDGE, ALBERTA

Incorporated 1935

Capital

Authorized—Common—A	$ 600,000
Common—B	1,000,000
Issued—Common—A	$ 525,000
Common—B	875,000
Consideration for issue of Capital—Cash	$ 400,000
Properties	1,000,000

	1936	1944
Properties—Net Valuation	$1,441,255	$1,015,984
Net Current Position	223,299	507,354
Surplus	69,557	143,614

Earnings Record

Profits—9 years

(a) Before Income Tax	$ 536,033
(b) After Income Tax	396,544

Annual Profit	1936	1939	1944
(a) Before Income Tax	$ 84,906	$ 37,934	$ 40,230
(b) After Income Tax	73,906	33,458	34,702

Dividend Record

Total Dividends Paid—9 years .... $ 306,000

Rate on Capital—1½ per cent for 1 year, 2 per cent for 1 year, 3 per cent for 4 years, and 5 per cent for 1 year.

Depreciation and Depletion

Total Depreciation (9 years) charged to Operations	$ 824,710
Total Depletion (9 years) charged to Operations	—

Assistance—Emergency Coal Production Board

Included in Accounts to 1944

Production Subsidies	Nil

Total Paid to March 31, 1946

(a) Production Subsidies	$ 118,605
(b) Loan	9,600

Production Record

Total Tonnage—9 years .... 2,729,071 tons

	1936	1939	1944
Annual Production (tons)	280,852	244,930	455,568
Per Man-day Production (tons)	3.48	3.27	3.46
Sales Realization—per ton	$ 3.15	$ 3.29	$ 3.69
Total Cost—per ton	3.00	3.26	3.80

BRITISH COLUMBIA

CANADIAN COLLIERIES (DUNSMUIR) LIMITED AND SUBSIDIARIES

NANAIMO, BRITISH COLUMBIA

In 1910 Canadian Collieries was incorporated, and acquired the holdings o the Wellington Securities in consideration of the issue of the following securities:

		Consideration
Common Shares	$10,000,000.00	Assignment to Company of agreement for sale with Wellington Securities.
Preferred Shares 7 per cent Cumulative	$ 5,000,000.00	Cash.
5 per cent First Mortgage Gold Bonds	$10,000,026.67	$9,500,000.00—Cash at $95.00

In 1914 an issue of £50,000 ($243,333.33)—6 per cent—3-year notes realized $200,000.

The Vancouver Island Coals Limited (formerly Wellington-Comox Agency Limited) was formed primarily for the purpose of enabling Canadian Collieries to raise moneys and secure advances. In 1914 it issued and sold at par £150,000 ($729,990) 7 per cent income bonds as security for a similar amount advanced to Canadian Collieries Limited. Under a scheme of compromise with the bondholders in the year 1920 the holders of these 7 per cent income bonds received $445,800 in 6 per cent serial bonds, which were subsequently redeemed by instalments and finally paid off in 1924. For the unpaid interest, amounting to $255,471.35, on the 7 per cent income bonds, the holders received 10,000 common shares of R. Dunsmuir Sons Company (of California) valued at $539,661.35, which shares had been the property of Canadian Collieries Limited.

The ordinary shares of Vancouver Island Coals ($500,000) were issued to Canadian Collieries in respect of the sales contract, and in the consolidated balance sheet of the various companies are shown at the nominal value of $1. This company is now the selling agency of the parent company.

As at June 30, 1920, a reorganization of the various companies was effected whereby the common shares were reduced from $10,000,000 to $100,000, or a decrease of $9,900,000. The preferred shares were reduced from $5,000,000 to $1,500,000 by the cancellation of shares to the extent of $3,500,000.

The 5 per cent first mortgage bonds of $10,000,026.67 were adjusted by a payment of $987,154.67 and the issue of "A" and "B" income debentures in the amount of $9,012,872.

The interest on the bonds was unpaid from March 1, 1914, to June 30, 1920, amounting to $3,799,888.47 and was settled by the issue of 185,196 preferred shares of $10 each ($1,851,960) and 925,980 common shares of $1 each ($925,980).

The sum of $272,141.81 was outstanding at June 30, 1920, in respect of the 6 per cent 3-year Treasury Notes, and in satisfaction there were issued 25,000 preferred shares of $10 each ($250,000).

According to the report of the Commissioner (The Hon. Mr. Justice M. A. Macdonald) in 1937, in connection with the affairs of this company, the above "rearrangement" of securities was adjusted in the books by the writing down of property values, the writing off on "discount on securities" and sundry adjustments to the profit and loss account.

In 1928 Canadian Collieries purchased the common shares of Western Fuel Corporation of Canada Limited, being 3,000,000 shares of $1 each, for a cash consideration of $1,725,000. Western Fuel owned and operated mines in and near Nanaimo, and the change of ownership did not affect the operations.

Western Fuel Corporation had outstanding 8 per cent sinking fund bonds amounting to $2,000,000 at the date of the acquisition of its common shares by Canadian Collieries. These bonds were redeemed in 1928 by the issue of 7 per cent sinking fund bonds in the amount of $2,000,000, and these bonds were finally redeemed by instalments which ended June 30, 1939.

Also in the year 1928 Wellex Securities was incorporated, the main function of this company being to purchase the income debentures (A and B) of Canadian Collieries with funds acquired from the parent company. Up to 1944 Wellex had purchased $2,427,031 of these income debentures at a cost of $369,435, resulting in a capital profit of $2,057,596.

As at June 30, 1944, the following securities were held by the public:

Common Shares (par value $1.00)	$ 1,025,980.00
Preferred Shares ($10.00 each)	3,601,960.00
Total Capital	$ 4,627,940.00
"A" Debentures	319,292.00
"B" Debentures	2,169,818.00
	$ 7,117,050.00

No dividends have been paid on either the 7 per cent preferred cumulative shares or on the common shares of the company.

In 1941, McLeod River Hard Coal Company (1941) Limited was incorporated with an ordinary share capital of $50,000, which shares were all issued to Wellex Securities for a consideration of the leasehold properties.

Debentures in the amount of $400,000 were also issued by the McLeod River Company, which are held by Wellex Securities Limited. The proceeds of these debentures have been invested in plant and equipment.

A chart, showing the inter-relationship of the various companies and the outstanding capital and funded debt as at June 30, 1944, is shown on the facing page.

As at June 30, 1930 and 1944, the Consolidated Balance Sheet of Canadian Collieries and its subsidiaries is summarized hereunder:

—	1930		1944	
	$	$	$	$
Assets—				
Properties, including coal lands	14,333,405		12,924,372	
Less depreciation and depletion reserve	4,465,255		7,332,229	
Net property value		9,868,150		5,592,143
Deferred charges, etc		237,642		132,947
Current assets	1,922,974		2,163,056	
Less current liabilities	249,874		516,335	
Net current position		1,673,100		1,646,721
		11,778,892		7,371,811
Liabilities—				
Share capital		4,627,940		4,627,940
Funded debt		6,785,608		2,489,110
Reserves				169,807
Surplus		365,344		84,954
		11,778,892		7,371,811

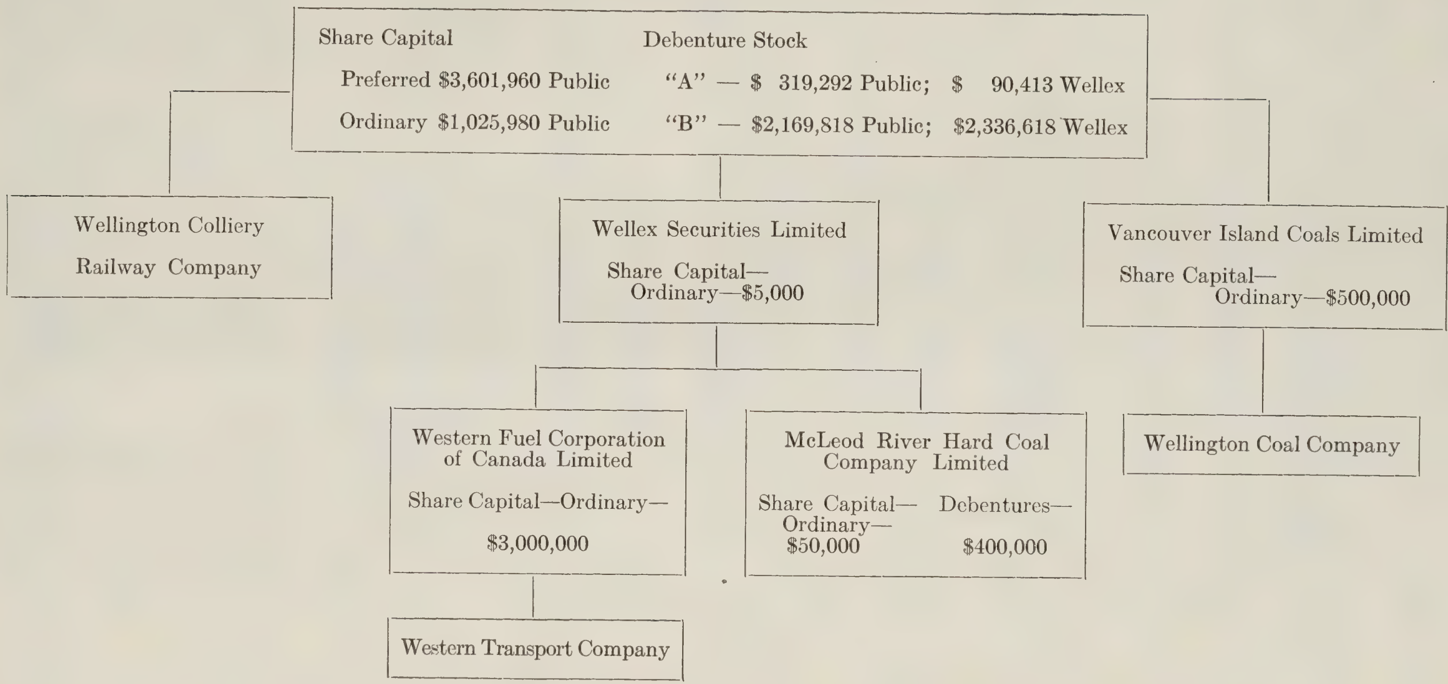
The property account is made up as follows:

Property Account (coal areas) after having been written down by $1,261,260.62 by charges to surplus and discount on Western Fuel bonds (1930-1944)		$ 5,610,843.29
Deduct		
Difference between par value of Western Fuel shares and cost to Wellex	$ 1,275,000.00	
Difference between reserves for inter-company investments of $1,703,233.88 and deficits in subsidiaries of $1,373,674.30	329,559.58	
Discount on "A" debentures held by Wellex	36,074.75	
Discount on "B" debentures held by Wellex	2,021,520.90	
		3,662,155.23
Property value (coal areas)		$ 1,948,688.06
Plant and equipment		10,975,684.46
Total book value		$ 12,924,372.52
Less depletion reserve (coal areas)	$ 539,212.70	
depreciation reserve (plant and equipment)	6,793,016.91	
		7,332,229.61
Net book value of properties and plant		$ 5,592,142.91

CANADIAN COLLIERIES (DUNSMUIR) LIMITED
AND SUBSIDIARIES

As at June 30, 1944

Canadian Collieries (Dunsmuir) Limited



CANADIAN COLLIERIES (DUNSMUIR) LIMITED VANCOUVER ISLAND, BRITISH COLUMBIA

SUMMARY OF OPERATING RESULTS—1930 TO 1944

—	1930 to 1935			1936 to 1939			1940 to 1944			Totals		
	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton	Percentage of Cost	Amount	Amount per Ton
		Tons			Tons			Tons			Tons	
Tonnage sold	....	4,250,643	....	....	2,712,461	....	....	3,217,674	....	....	10,180,778	....
		$	$		$	$		$	$		$	$
Realization	....	21,035,388.61	4.949	....	13,220,132.86	4.874	....	17,636,374.77	5.481	....	51,891,896.24	5.097
Deduct Costs												
Labour	49.891	10,428,023.23	2.453	50.462	6,810,034.76	2.511	50.345	9,126,834.59	2.836	50.195	26,364,892.58	2.590
Material	10.106	2,112,255.63	0.497	11.300	1,525,015.32	0.562	10.060	1,823,756.69	0.567	10.397	5,461,027.64	0.536
Power	7.879	1,646,916.24	0.387	7.058	952,522.31	0.351	3.139	568,978.79	0.177	6.032	3,168,417.34	0.311
Royalties	1.488	311,079.40	0.073	1.419	191,533.30	0.071	1.363	247,110,60	0.077	1.427	749,723.30	0.074
Workmen's Compensation Bd	2.179	455,545.29	0.107	2.325	313,801.61	0.116	3.621	656,492.67	0.204	2.715	1,425,839.57	0.140
Other Mining Costs	13.734	2,870,548.43	0.675	14.754	1,991,037.46	0.734	19.389	3,514,884.95	1.093	15.948	8,376,520.84	0.823
Administration and Overhead	6.642	1,388,318.80	0.327	7.674	1,035,669.10	0.382	5.848	1,060,142.70	0.329	6.633	3,484,130.60	0.342
	91.919	19,212,687.02	4.519	94.992	12,819,663.86	4.727	93.765	16,998,200.99	5.283	93.347	49,030,551.87	4.816
Depreciation	7.580	1,584,296.43	0.373	4.470	603,183.57	0.222	5.785	1,010,534.55	0.314	6.161	3,198,014.55	0.315
Depletion	0.501	104,623.70	0.025	0.538	72,597.20	0.027	0.450	81,514.70	0.025	0.492	258,735.60	0.025
Total Cost	100.000	20,901,607.15	4.917	100.000	13,495,444.63	4.976	100.000	18,090,250.24	5.622	100.000	52,487,302.02	5.156
Operating Profit or *Loss*	....	133,781.46	0.032	....	*275,311.77*	*0.102*	....	*453,875.47*	*0.141*	....	*595,405.78*	*0.059*
Add Investment Income, etc	....	297,663.64	0.070	....	195,881.08	0.072	....	240,343.18	0.075	....	733,887.90	0.072
Government Assistance	....	....	....	....	....	....	....	311,032.39	0.097	....	311,032.39	0.030
Sundry Revenue	....	631,304.26	0.149	....	413,723.96	0.153	....	726,026.39	0.226	....	1,771,054.61	0.174
	....	1,062,749.36	0.251	....	334,293.27	0.123	....	823,526.49	0.257	....	2,220,569.12	0.217
Deduct Montreal and London Expense, etc	....	233,016.58	0.055	....	132,784.81	0.049	....	255,618.44	0.080	....	621,419.73	0.061
Bond Interest (Western Fuel)	....	582,580.19	0.137	....	26,559.92	0.010	....	....	....	....	609,140.11	0.059
Bond Interest (Cdn Collieries)	....	316,887.48	0.075	....	103,284.64	0.038	....	176,286.53	0.055	....	596,458.65	0.058
Profit or *Loss* before Income Taxes	....	*69,734.89*	*0.016*	....	71,663.90	0.026	....	391,621.52	0.122	....	393,550.63	0.039
Deduct Income Taxes	....	5,953.53	0.001	....	....	....	....	44,861.62	0.014	....	50,815.15	0.005
Net Profit or *Loss*	....	*75,688.42*	*0.017*	....	71,663.90	0.026	....	346,759.90	0.108	....	342,735.48	0.034
If depletion were entered at 10 cents per ton on coal raised, additional charges would be necessary of	....	356,377.60	0.084	....	245,137.80	0.090	....	321,709.90	0.100	....	923,225.30	0.091
making a Net Profit or *Loss* of	....	*432,066.02*	*0.101*	....	*173,473.90*	*0.064*	....	25,050.00	0.008	....	*580,489.82*	*0.057*
Redemption of "A" Debentures charged to Surplus	....	456,114.14	....	....	131,226.95	....	....	257,450.19	....	....	844,791.28	....

During the fifteen-year period the plant and equipment account has increased by over $1,100,000.

It will also be observed that the company has an excess of current assets over immediate liabilities of $1,646,721.

Between 1930 and 1944 the funded debt has been reduced by $4,300,000 through the redemption of the "A" debentures and by the purchase by Wellex of the "B" debentures at a very considerable discount. Since its inception Wellex has purchased $2,336,618 of "B" debentures at a discount of 87 per cent for $315,097, and "A" debentures of a par value of $90,413 at a cost of $54,338.

Operating Results

A summary of the operating results over the fifteen years is shown on the statement facing this page.

The tonnage (some 10,000,000 tons) represents approximately 5 per cent of the total tonnage sold in Canada by Canadian companies over these years.

On the coal operations this company has lost 6 cents per ton, after charging 34 cents per ton for depreciation and depletion.

When sundry revenues less sundry expenses are taken into account a profit of 4 cents per ton is shown, which was reduced by income taxes to 3.5 cents. Before the profit of 3.5 cents per ton was determined bond interest of 11.7 cents per ton, amounting to $1,205,598.76, was charged.

The annual charge for depreciation varies over the period—from a low of 18 cents in 1937 to a high of 52 cents per ton in 1943. The provision, to a large extent, is governed by the final operating result. The average charge for depletion is 2.5 cents per ton and, if an additional charge were made to bring the depletion to 10 cents per ton on coal raised, the over-all loss would be 5.5 cents per ton.

Of the Government assistance of $311,032.39 for the years 1942-1944, the sum of $156,933.53 was received in production subsidies from the Emergency Coal Production Board, the balance being represented by subventions and cost-of-living bonuses. To March 31, 1946, additional production subsidies amounting to $550,210.80 have been received, bringing the total subsidies to $707,144.33.

During the period 1934-1944 this company has recived from the Dominion Government $1,157,652.52 in subvention moneys in respect of bunker coal. Of this total, $434,310.94 was paid to ship owners, $98,090.14 was put in a reserve, and the balance of $625,251.44 was taken into the accounts to adjust the price of the coal sold to these customers.

Using the period 1936-1939 as a base of 100 and including in the cost depreciation and depletion, as entered in the books of the company, the immediate prior period and subsequent war years compare with the standard period in respect of costs and sales as follows:

	Sales	Costs
1930–1935	101.5	98.7
1936-1939	100.0	100.0
1940-1944	112.4	113.0

The operating profit or loss, before bond interest, sundry expense and sundry revenues, including some government assistance for the above periods, is a profit of 3 cents, a loss of 10 cents and a loss of 14 cents per ton, respectively.

Using representative years, the net profit or loss per ton is summarized below, before provision for income taxes and for interest on the income debentures:

—	1930	1935	1939	1944
	$	$	$	$
Sales	5.187	4.792	5.003	6.188
Sundry Revenue	0.167	0.131	0.212	0.194
Investment Income	0.049	0.073	0.078	0.059
	5.403	4.996	5.293	6.441
Deduct				
Mining and Operating Cost	4.504	4.393	4.963	6.050
Depreciation and Depletion	0.502	0.383	0.204	0.430
Other charges, including Western Fuel bond interest	0.200	0.084	0.071	0.146
	5.206	4.860	5.238	6.626
Net profit or *loss*	0.197	0.136	0.055	*0.185*
Government assistance	....	....	....	0.290
Net profit, after assistance	0.197	0.136	0.055	0.105

The sales by this company have been made over the fifteen years to the following classes of customers:

	Tons
Railways	1,593,199
Bunkers	1,337,486
Dealers	3,231,603
Commercial	3,396,743
Employees, local and company	999,613
	10,558,644

The above sales include purchased coal and coal mined during development, the proceeds of which are credited to the development cost.

Comparative direct mining costs for all collieries are shown for certain years in the undernoted tabulation:

—	Mining and Loading	Inside Labour and Material	Outside Labour and Material	Power, W.C.B. etc.	Total Mining Cost	Individual Collieries' Mining Costs	
						Highest	Lowest
	$	$	$	$	$	$	$
1930	1.182	1.492	0.459	0.527	3.660	4.705	2.722
1935	1.032	1.281	0.462	0.495	3.270	4.081	2.444
1939	1.174	1.450	0.472	0.476	3.572	3.759	3.341
1944	1.368	1.908	0.553	0.544	4.373	5.505	3.889

The production per man-day in the years 1936-1944 varies from a low of 1.67 tons per day in 1939 to a high of 2.29 tons in 1942. The 1944 production was 2.24 tons per man-day.

McLeod River Hard Coal Company (1941) Limited

As the statement of assets and liabilities of Canadian Collieries includes the subsidiary companies, the operating statements of this coal-producing subsidiary are submitted in the following pages.

McLEOD RIVER HARD COAL COMPANY (1941) LIMITED

Mercoal, Alberta

This coal-producing subsidiary was incorporated in 1941, and its ordinary share capital of $50,000 was issued to Wellex Securities Limited in consideration of the leasehold properties.

Debentures in the amount of $400,000 were sold to the Wellex Company and the proceeds invested in plant and equipment.

The financial position as at June 30, 1944 (previously included in the consolidated balance sheet of Canadian Collieries) is as under:

Assets—	
Net properties	$ 440,391
Net current position	74,994
	$ 515,385
Liabilities—	
Capital—common shares	$ 50,000
Debentures	400,000
Advances by Wellex Securities Limited	169,321
Deficit	*103,936*
	$ 515,385

Operating Results

The operations for the years 1942-1944 show net results as follows:

1942	$ 21,311.50 (loss)
1943	4,184.32 (profit)
1944	24,495.73 (loss)
	$ 41,622.91 (loss)

The above losses are after inclusion of production subsidies of $58,410.27 received from the Emergency Coal Production Board.

A summary of the profit and loss account on a per-ton basis for the three years is shown hereunder:

—	1942	1943	1944
	Tons	Tons	Tons
Sales—Tonnage	90,721	140,966	170,104
	$	$	$
Sales value	3.395	3.564	3.905
Deduct costs			
Mining	3.377	3.314	3.923
Royalties, management etc	0.350	0.298	0.355
Depreciation	0.035	0.095	0.127
	3.762	3.707	4.405
Loss on operations	*0.367*	*0.143*	*0.500*
Sundry revenue	0.132	0.143	0.038
Subsidies	....	0.030	0.318
Net profit or *loss*	*0.235*	0.030	*0.144*

Up to March 31, 1946, this company received total production subsidies from the Emergency Coal Production Board of $166,597.53.

SUMMARY

CANADIAN COLLIERIES (DUNSMUIR) LIMITED, NANAIMO, B.C.

Incorporated 1910

Capital	
Issued—Common	$ 1,025,980
Preferred	3,601,960
Consideration for issue of Capital—	
Cash	$ 4,527,940
Properties	100,000

	1930	1944
Properties—Net Valuation	$ 9,868,150	$ 5,592,143
Net Current Position	1,673,100	1,646,721
Surplus	365,344	84,954

Earnings Record	
Profits—15 years	
(a) Before Income Tax	$ 393,551
(b) After Income Tax	342,735

Annual Profit	1930	1935	1939	1944
(a) Before Income Tax	$ 106,915	$ 50,349	$ 12,060	$ 13,895
(b) After Income Tax	106,915	46,680	12,060	13,895
(c) Debenture Interest charged	78,602	36,568	20,337	55,985

Dividend Record	
Total Dividends Paid—15 years	Nil
Depreciation and Depletion	
Total Depreciation (15 years) charged to Operations	$ 3,198,015
Total Depletion (15 years) charged to Operations	258,736
Assistance—Emergency Coal Production Board	
Included in Accounts to 1944	
Production Subsidies	$ 156,933
Total Paid to March 31, 1946	
Production Subsidies	$ 707,144
Production Record	
Total Tonnage—15 years	11,819,609 tons

	1930	1935	1939	1944
Annual Production (tons)	969,173	694,012	729,255	815,147
Per Man-Day Production (tons)	—	1.7	1.67	2.24
Sales Realization—per ton	$ 5.18	$ 4.79	$ 5.00	$ 6.18
Total Cost—per ton	5.29	4.92	5.66	6.83

REMARKS.—All profit and loss and cost figures include the "A" Income Debenture interest paid.

SUMMARY

MACLEOD RIVER HARD COAL COMPANY (1941) LIMITED,
MACLEOD RIVER, ALBERTA

Incorporated 1941

Capital		
Authorized—Common	$ 50,000	
Issued—Common	$ 50,000	
Consideration for issue of Capital— Lease	$ 50,000	
		1944
Properties—Net Valuation		$ 440,391
Net Current Position		74,994
Deficit		*103,936*
Earnings Record		
Losses—3 years		
(a) Before Income Tax	$ *41,623*	
(b) After Income Tax	*41,623*	
Annual *Loss*		1944
(a) Before Income Tax		$ *24,496*
(b) After Income Tax		*24,496*
Dividend Record		
Total Dividends Paid—15 years	Nil	
Depreciation and Depletion		
Total Depreciation (3 years) charged to Operations	$ 38,139	
Total Depletion (3 years) charged to Operations	Nil	
Assistance—Emergency Coal Production Board		
Included in Accounts to 1944		
Production Subsidies	$ 58,410	
Total Paid to March 31, 1946		
Production Subsidies	$166,598	
Production Record		
Total Tonnage—3 years	301,791 tons	
		1944
Annual Production (tons)		170,104
Sales Realization—per ton		$ 3.905
Total Cost—per ton		4.405

TULAMEEN COLLIERIES LIMITED

Financial information was obtained from only one inland company, Tulameen Collieries Limited, of Princeton, B.C., incorporated in 1942, and particulars thereof follow:

Capital		
Authorized—Common	$100,000	
Issued—Common	$100,000	
Consideration for issue of Capital—Cash, Properties	$ 10,815	
Goodwill	89,185	
		1944
Properties—Net Valuation		$ 105,654
Net Current Position		*3,740*
Surplus		1,991
Earnings Record		
Profits or *Losses*—3 years		
(a) Before Income Tax	$ 1,341	
(b) After Income Tax	*3,981*	
		1944
Annual Profit		
(a) Before Income Tax		$ 8,822
(b) After Income Tax		3,500
Dividend Record		
Total Dividends Paid—3 years	Nil	
Depreciation and Depletion		
Total Depreciation (3 years) charged to Operations	$ 3,444	
Total Depletion (3 years) charged to Operations	8,398	
Assistance—Emergency Coal Production Board		
Included in Accounts to 1944 Production Subsidies	$ 14,774	
Total Paid to March 31, 1946 Production Subsidies	$ 17,249	
Production Record		
Total Tonnage—3 years	58,809 tons	
		1944
Annual Production (tons)		35,700
Per Man-Day Production (tons)		3.1
Sales Realization—per ton		$ 4.49
Total Cost—per ton		4.42

RECAPITULATION

Method of Accounting

From a careful perusal and study of the foregoing material, it is evident that there is a lack of uniformity in the accounting procedures adopted by the producing companies. Some companies maintain very elaborate and detailed cost records, while others reduce their distribution of costs to the very minimum. There is also a very wide variation in the classification of charges, depending to a large extent on the requirements of the mine managers.

However, the main and most vital difference between the companies is the treatment accorded items which may be of either a capital or revenue nature, depending upon the policy adopted by each company.

The methods determined by management policy may be briefly summarized as follows:

(1) After the colliery has been put on the determined commercial production, all expenditures are classified as operating expense, unless such expenditure:

(a) Increases the daily initial production, and/or

(b) Decreases the cost of production, and/or

(c) Increases the available reserves of coal.

(2) The useful life of the item for which the expenditure is made is the determining factor in arriving at the distribution as between capital and operation. The years of life is also the means of ascertaining the rate at which such item is depreciated.

In addition, after the mine has been put on commercial production all further development work, such as tunnels, airways, extensions, etc., is charged to a "development account" and recovered from operations through a charge to mining costs at varying rates per ton; thus having the effect of spreading or deferring the expenditure over a period of years.

(3) In anticipation of replacement expenditures or costs of contingencies which may occur in this hazardous industry, such as fire losses, floods, cave-ins, explosions, et cetera, an amount per ton is charged to mining costs and set up as a reserve. The disbursements, when made, are then charged to the established reserve.

There has not been a great deal of literature written on the subject of coal mine accounting, but the National Coal Association, U.S.A., in 1919 recommended:

> After a coal mine has been developed and equipped to its planned capacity, charges to its capital account should cease . . . etc.
>
> Usually after one-third or one-half the life of the mine has elapsed, additions to power plant and major items of equipment will be necessary, and the cost thereof should be set up in appropriate additions and betterments accounts, and for these will have to be established an additional and separate depreciation rate based on the remaining coal or life of the mine.
>
> The costs of additions and betterments, so large that such costs should be capitalized, must be redeemed by setting aside from gross income adequate provision for reimbursing such cost during the life of the mine.

It should be observed that the recommendations of the National Coal Association vary the Method 1, as by that method no costs of additions or betterments would be capitalized, unless they meet the requirements as set forth.

The Bureau of Internal Revenue of the United States, in its regulations in respect of taxation of mining companies, rules:

> All expenditures . . . shall be charged to capital account while the mine is in the development stage. Thereafter any development which adds value to the mineral deposit beyond the current year shall be carried as a deferred charge, and apportioned and deducted as operating expenses in the years to which it is applicable.
>
> All expenditures for plant and equipment shall be charged to capital while the mine is in the development stage. Thereafter, the cost of major items of plant and equipment shall be capitalized, etc. . . .

The Emergency Coal Production Board of the Dominion Government, which determines if subsidies are payable to operating producing companies in order to increase production during the national emergency, has made the following regulation with regard to costs:

> Articles having a comparatively short life should be replaced out of income and charged directly to costs under the heading of "stores". For example, depreciation would be warranted on head frames, haulage, machinery, conveyors, coal trucks, coal cutting and drilling machines, et cetera, but not on rails, piping, shaft and haulage roads, fitments, wiring, tools, et cetera. . . .
>
> There shall not be included as a cost the following, unless approved by this Board or other competent authority:—Extraordinary expenses, such as new mine development, fire losses, floods, cave-in, et cetera.

The Income Tax Division of the Dominion Government has not issued any rulings on mining companies in respect of this particular matter, but deals with each case on its merits.

From the foregoing explanation of the various accounting treatments given to certain expenditures by the coal companies, each of which has the support of some precedent, use or authority, it will be appreciated that in consequence of the method employed the amount of "cost" and also of annual "profit" will vary accordingly.

In varying degrees all of the companies surveyed differ from one another, but it would appear that there is some uniformity in the general procedure in the accounts of the producers of the Western Provinces, most of which adopt the second method.

Method No. 1 has been adopted by the Dominion Coal and associated companies in Nova Scotia. Their practice for many years has been to charge items of a capital or deferable nature to operations in the years in which the disbursement was made. To bring this procedure onto a comparable basis with other companies it would be necessary to revise the costs for the past fifteen years or longer, as it would obviously be unfair to change the accounting methods in any one period without having due regard to the effect of this change on the operations of previous periods. Revisions made on this basis have resulted in reduced costs for the years 1943 and 1944.

In our opinion, however, the adjustments made (in view of the size of the operations) will not have any material effect on the annual results insofar as our study is concerned.

Various departments of the Dominion Government are vitally interested in the annual financial statements of the coal-producing companies—the Income Tax Division, as to the taxable profits; the Dominion Fuel Board, in respect of the payment of subventions; and the Emergency Coal Production Board, in respect of the payment of subsidies.

All of these departments arrive at their respective conclusions as to how much income tax the company has to pay, or as to the amount of assistance that will be granted to the company on an appraisal and examination of the annual profit and loss statement. We are of the opinion that, insofar as government departments are concerned, a condition should not exist where different systems of accounting may give varying results for a given period in the one industry.

Financial Results

In this section is presented a summary of the capital employed in Canadian coal mines and the return on this investment which is then further reviewed by periods and by areas.

Financial Position

Capital employed, as shown by the books of the companies, as at the end of the companies' fiscal years in 1944 or 1945:

Gross property values, including the value of coal lands, leases, plant, equipment, etc	$127,746,407
From operations the companies have recovered through depletion and depreciation charges the sum of	67,706,240
making the net value	$ 60,040,167
These companies have on hand net current assets, which include cash, investments, accounts receivable, inventories, prepaid expenses, etc., of	22,871,133
or total depreciated assets of	$ 82,911,300

The above capital has been provided:

Through the issuance of shares or proprietors' contributions of	$ 64,396,969
Through the sale of bonds	8,933,311
And through operations, as represented by reserves and undistributed income, of	9,581,020
	$ 82,911,300

In reviewing the term "capital employed", regard must be had to the gross property values as shown above. A substantial proportion of the share capital of the companies surveyed was issued in respect of coal lands and/or coal lands which included some plant, equipment and development work. As these transactions took place in some instances more than fifty years ago, it is not possible at this date to arrive at a definite value for those properties. In many cases, however, because of the mines' earning capacities, it is reasonable to assume that the coal lands have a value approximate to that placed on them in the books. In some instances this is not quite so apparent, but for the purposes of this chapter those values have been accepted in ascertaining the capital employed.

Employing the foregoing capital to extract the coal from properties which are, in the main, leased on a royalty basis from the provincial governments in which the mines are situated, the companies involved have sold a total of 180,969,795 short tons, which compares with the total Canadian sales of some 230,000,000 tons over the fifteen-year period. The difference of approximately 49,000,000 tons, or an annual average of 3,000,000 tons, was produced by innumerable small companies, by companies which are not presently in existence, or by companies which have either changed ownership or for other reasons the records are not now available.

In some companies long tons are used in the accounting records. As all statistical data of the Dominion Government, Income Tax Department allowances, et cetera, are based on short tons, we have converted all calculations to short tons in the material presented herewith.

Coal Sold

An analysis of the coal sold by the above mentioned companies (by districts in Canada) is shown in the following tabulation:

—	Tons			Percentage
Dominion Coal Co. Ltd	57,465,239			
Old Sydney Collieries Ltd	9,476,457			
Cumberland Railway and Coal Co	8,785,296			
Acadia Coal Co. Ltd	6,290,481	82,017,473		45.3
Cape Breton Island	2,669,299			
Nova Scotia—Mainland	4,501,211			
New Brunswick	4,543,656	11,714,166		6.5
			93,731,639	51.8
Bituminous Mines—				
Alberta and South Eastern British Columbia		44,364,211		
Alberta—Drumheller Field		11,920,076		
Northern Field		4,035,694		
South and Central		4,190,641		
Stripping (privately financed)		5,057,237	69,567,859	38.4
Vancouver Island			10,180,778	5.6
Saskatchewan			7,489,519	4.2
Total Tonnage Sold			180,969,795	100.0

Note.—The stripping operations in Alberta financed by the Emergency Coal Production Board and which produced 843,930 tons up to March 31, 1946, are not included in the above tabulation, as the foregoing sales of 180,969,795 were up to the end of 1944.

Sales Realization

A summary of the selling value and cost of producing and selling the above tonnage is shown hereunder:

—		Amount	Per Ton
		$	$
Sales realization		729,290,231.57	4.030
Deduct Costs—			
Agency and shipping expenses		95,298,353.95	0.527
Labour		366,957,930.81	2.028
Material		67,964,985.52	0.376
Power		38,220,477.34	0.211
Taxes and rentals		8,918,148.08	0.049
Royalties		15,582,779.74	0.086
Workmen's Compensation Board		17,579,067.33	0.097
Other mining costs, which include insurance, freight, banking, washing, etc., and in cases where allocation of costs is not possible the total cost of such operations		49,706,657.64	0.275
Administration and overhead		38,247,148.97	0.211
		698,475,549.38	3.860
Depreciation and development		30,024,593.84	0.166
Total cost		728,500,143.22	4.026
Profit on mining—before any provision for depletion		790,088.35	0.004
Add sundry revenue, which includes profits on briquetting and coking operations, profits on utilities owned, profit on purchased coal, investment income, etc		21,671,440.72	0.120
		22,461,529.07	0.124
Deduct bond interest	$ 9,041,499.90	....	....
sinking fund provision	3,072,083.36	....	....
rentals to owners	1,695,173.14	13,808,756.40	0.076
Profit—before subsidies, depletion and income taxes		8,652,772.67	0.048
Add subsidies—Dominion Government		14,859,295.83	0.083
assistance—Provincial Government		313,551.87	0.001
Profit—before income taxes and depletion		23,825,620.37	0.132
Deduct income taxes		6,357,135.60	0.035
Net profit—before provision for depletion		17,468,484.77	0.097
Depletion has been set up on the books of the companies, totalling		7,574,235.82	0.042
Which makes a net profit shown by their books of		9,894,248.95	0.055
If depletion were entered at 10 cents per short ton, a further charge would be necessary of		10,522,743.68	0.058
Making a net loss of		628,494.73	0.003

Taking the industry as a whole, it is apparent from the foregoing result that the net earning is approximately equal to the depletion allowance of 10 cents per ton.

Earlier in this section a more detailed factual analysis of the operating results of the producing companies in Canada is given.

Using the three periods as mentioned previously, a further analysis of the results of operations is shown below:

—	Tonnage	Profits before Taxes and Depletion	Income Taxes	Net Profit after Income Taxes and before Depletion
		$	$	$
1930–1935	54,713,429	3,704,660.52	670,952.20	3,033,708.32
1936–1939	46,904,619	4,890,309.99	874,142.86	4,016,167.13
1940–1944	79,351,747	15,230,649.96	4,812,040.54	10,418,609.32
	180,969,795	23,825,620.37	6,357,135.60	17,468,484.77

Geographically the above results have been as follows:

Period	Eastern Companies		Western Companies (Profit)		Total (Profit)	
	Tons	Amount	Tons	Amount	Tons	Amount
		$		$		$
1930–1935	31,353,422	*2,423,294.50 loss*	23,360,007	5,457,002.82	54,713,429	3,033,708.32
1936–1939	26,769,579	509,368.85 profit	20,135,040	3,506,798.28	46,904,619	4,016,167.13
1940–1944	35,608,638	2,226,927.08 profit	43,743,109	8,191,682.24	79,351,747	10,418,609.32
	93,731,639	313,001.43 profit	87,238,156	17,155,483.34	180,969,795	17,468,484.77

An elaboration of the above results, together with some of the pertinent factors is now given:

PERIOD 1930-1935 (DEPRESSED)

Of the total net earnings of $3,000,000, a segregation as between districts and profitable and non-profitable operation is as follows:

MARITIMES—	Tonnage	Net Result
Four Dosco companies	28,030,885	$ *3,008,433.08 loss*
The above loss is after charging $6,636,011.51 in bond interest and sinking fund, of which the sum of $620,726.33 was not paid but capitalized in subsequent years, and $436,064.83 in rentals to the parent company.		
Other Nova Scotia Companies— Four companies	1,934,027	$ 396,725.44 profit
New Brunswick Companies— One company	267,809	*68,783.94 loss*
Five companies	1,120,701	257,197.08 profit
Total Results—Maritimes	31,353,422	$ *2,423,294.50 loss*

Two of the Maritime companies show net earnings of 36 cents per ton, three make net profits of from 20 cents to 23 cents, three others 18 cents and 19 cents, while two show less than one cent and the remaining four suffered losses of from five cents to 59 cents per ton.

Mining costs range between $3.01 and $4.01 per ton, and labour represents approximately 57 per cent of the total cost for the Maritime companies. Other items included in the costs are:

	$	Cents per ton
Taxes and rentals	2,035,340.40	6.5
Royalties	3,276,562.37	10.5
Workmen's Compensation Board	1,968,506.06	6.3
Depreciation	3,470,691.57	11.1
Income taxes	48,925.82	0.1
Administration	6,184,895.94	19.7

Royalties are paid to the Province of Nova Scotia at the rate of 12.5 cents per long ton on commercial coal mined, and at the rate of 9 cents per short ton in New Brunswick.

The man-day production (by companies) ranges from a low of 1.1 tons to 3 tons.

SASKATCHEWAN COMPANIES	Tonnage	Net Result	
One company	612,173	$1,235.62	profit

Low grade coal is mined in Saskatchewan which had an average selling value of $1.49 per ton during this period with costs of $1.46. Labour represents 42 per cent of the cost. Depreciation is included at the amount of 12.5 cents per ton.

ALBERTA AND EASTERN BRITISH COLUMBIA—BITUMINOUS	Tonnage	Net Result	
Nine Companies	12,627,154	$4,611,099.55	profit

Of these nine companies, one shows a loss of 1.6 cents per ton while the other eight had net earnings of 16 cents, 24 cents, 28 cents, 37 cents, 42 cents, 58 cents, 63 cents and 73 cents per ton.

Realization varies between $3.17 and $3.91 per ton, with costs from $2.80 to $3.92.

Labour, including compensation, is 57 per cent of the total cost. Man-day production (by companies) ranges between 2.5 tons and 4.4 tons.

Some of the items included in the operating statement are:

	$	Cents per ton
Taxes and rentals	798,591.94	6.3
Royalties	845,485.54	6.7
Workmen's Compensation Board	868,477.60	6.9
Depreciation	3,330,709.55	26.3
Income taxes	567,494.50	4.5
Administration	3,708,661.64	29.4

In addition to annual lease rentals of $1 per acre, royalties are payable to the Province of Alberta at the rate of 5 cents and 7 cents per ton, depending on date of acquisition of lease. The rate in British Columbia is 10 cents per ton.

ALBERTA—DRUMHELLER FIELD	Tonnage	Net Result	
One company	177,160	$ *40,831.14*	*loss*
Six companies	2,276,555	$ 740,868.50	profit

Profits are shown by six of these companies in the domestic coal area of ½ cent, 10 cents, 17 cents, 18 cents, 37 cents and 64 cents per ton, while the other shows a loss of 23 cents.

Realization per ton is from $2.50 to $2.99, with costs varying from $2.05 to $3.12.

Labour, including compensation, represents 56 per cent of the total cost, and the man-day production in these mines is generally higher than in other fields. One mine reaches the highest production per man-day of all underground mines in Canada, with 7 tons per man-day. The other mines produce from 3 to 5.6 tons per man-day for all labour.

Taxes amount to 14 cents per ton, royalties to 6 cents, compensation is 6 cents, income taxes less than 1 cent, and administration and overhead 35 cents per ton.

ALBERTA—EDMONTON DISTRICT	Tonnage	Net Result	
Two companies	140,316	$ *1,387.17*	*loss*
Two companies	889,958	$47,340.00	profit

Coal sold from mines in this area realizes from $1.87 to $2.37, with costs ranging from $1.90 to $2.45 per ton.

Of these four companies, two show losses of 1 cent per ton, while the other two have profits of 3 cents and 7 cents per ton.

Per-ton costs for taxes and rentals amount to 3 cents, royalties 12.4 cents, compensation 7 cents and administration 12.2 cents.

Income taxes were paid of $6,840.88, which is the equivalent of 7/10 cents per ton.

ALBERTA—SUNDRY FIELDS	Tonnage	Net Result	
Two companies	261,254	$ *280,882.11*	*loss*
One company	291,660	$ 7,055.00	profit

Realization for these mines is from $3.42 to $3.96 per ton, with costs of from $3.62 to $4.68.

The losses as shown include bond interest, of which the amount of approximately $68,000.00 has not been paid.

Losses are shown of 36½ cents and $1.99 per ton by two of the companies. The latter loss includes bond interest charges of $1.75 which have not been paid. The other company shows a profit of 2.4 cents per ton.

Taxes and rentals amount to 7 cents per ton, royalties to 7 cents, compensation 10.8 cents, depreciation 30 cents, and administration and overhead 35.3 cents.

ALBERTA—STRIPPING OPERATION

(Privately Financed)	Tonnage	Net Result	
Three Companies	1,833,134	$ 343,569.29	profit

These three companies show profits of 17.4 cents, 18.8 cents and 19.4 cents per ton over this period. The coal sold realizes from $1.62 to $2.34 per ton, with costs of $1.50 to $2.28.

Costs include taxes and rentals of 3.7 cents, royalties 4.3 cents, compensation of 2.8 cents and administration and overhead of 32.4 cents. Depreciation and development written off amounts to 15.4 cents per ton.

BRITISH COLUMBIA—VANCOUVER ISLAND	Tonnage	Net Result	
One company	4,250,643	$ 28,935.28	profit

This company realized a profit of 8/10 cents per ton on sales averaging $4.95 per ton, which is the highest selling price of all the Canadian companies. Costs are also the highest, as they average $4.94 per ton.

Royalties paid amount to 7.3 cents, compensation is 10.7 cents, administration is 38.5 cents and depreciation charged in the books totals 37.3 cents per ton.

TOTAL—ALL COMPANIES (42) 1930-1935	54,713,429	$ 3,033,708.32	profit

Summary of Period 1930 to 1935

Over these six years there were 42 companies surveyed as to their financial position and operating results. The amounts, in all cases, are before any charge for depletion.

Of the 42 companies, 4 in the East report *losses* of	$ *3,693,281.84*
Six in the West report *losses* of	*354,814.15*
TOTAL *losses*—ALL COMPANIES (10)	$ *4,048,095.99*

In the eastern provinces there were:—

Six companies reporting average annual earnings of under $10,000.00	$ 170,046.17
Two companies with annual profits of from $10,000.00 to $15,000.00	165,308.63
One company with annual profits of $50,000.00	318,567.72
One company with annual profits of $100,000.00	616,064.82
TOTAL PROFITS—EASTERN COMPANIES (10)	$ 1,269,987.34

In the western provinces there were:—

Eight companies showed net revenue of $10,000.00 per year, or less	$ 123,972.35
One company whose annual profits were from $10,000.00 to $15,000.00	66,091.21
Five companies whose annual profits were from $20,000.00 to $30,000.00	733,672.59
Two companies whose average profits were $56,000.00	565,056.73
Three companies whose average profits were from $80,000.00 to $100,000.00	1,503,334.39
Two companies whose average profits were $157,000.00	1,572,666.86
One company whose average profits were $200,000.00	1,247,022.84
TOTAL PROFITS—WESTERN COMPANIES (22)	$ 5,811,816.97

Total net *losses*—Eastern Companies (14)	$ *2,423,294.50*
Total net profits—Western Companies (28)	5,457,002.82
NET PROFITS—ALL COMPANIES (42)—1930 TO 1935 PERIOD	$ 3,033,708.32

PERIOD 1936-1939 (NORMAL OR STANDARD)

Of the total net earnings of 4,000,000 dollars, a segregation as between coal-producing areas and profitable and non-profitable operations is shown in the following summary:

MARITIMES—	Tonnage		Net Result	
Four Dosco companies	23,760,351	$	71,254.64	profit

The above result is after charging $2,502,930.16 in bond interest and sinking fund, of which the sum of $400,880.11 was not paid but satisfied by the issue of shares.

	Tonnage		Net Result	
Other Nova Scotia companies—				
Three companies	1,567,338	$	414,302.92	profit
One company	185,047		*2,922.18*	*loss*
New Brunswick companies—				
Four companies	672,576		119,731.95	profit
Three companies	584,267		*92,998.48*	*loss*
TOTAL RESULTS—MARITIMES	26,769,579	$	509,368.85	profit

During these 4 years some improvement is shown by the Nova Scotia companies, but the New Brunswick operations show decreased earnings as compared with the prior period. The Dominion Coal Company realization increases by 4 cents a ton and their costs decrease by 5 cents.

With selling prices per ton varying from $3.22 to $4.09, 3 of the companies show an increase in average realization while 11 have decreased selling values.

Costs range from $3.28 to $4.60 per ton, with 4 companies having increased costs and ten decreased costs.

Labour represents from 55 per cent to 63 per cent of the total cost. During this period the Nova Scotia companies show an increased man-day production, with from 1.4 to 2.9 tons per man-day. Not much change is evident in the New Brunswick companies, with the average production 1.3 tons.

Included in the costs are the following items:—

	$	Cents per ton
Taxes and rentals	1,384,570.34	5.2
Royalties	2,890,335.15	10.8
Compensation	2,441,154.49	9.1
Depreciation	5,034,659.33	18.8
Administration	4,014,446.68	15.0

Income taxes were charged in the amount of $346,323.45 to profits, with a further transfer from other reserves of $400,000.

SASKATCHEWAN COMPANIES	Tonnage		Net Result	
One company	800,183	$	90,847.45	profit

Sales realize $1.43 per ton, with costs averaging $1.31. Net profits amount to 14 cents per ton, after charging 11 cents in depreciation. Production per man-day averages over 6 tons.

ALBERTA AND EASTERN BRITISH COLUMBIA—
BITUMINOUS—

	Tonnage	Net Result	
Nine companies	10,153,851	$ 2,659,530.21	profit

Profits are earned by these companies in the per-ton amounts of 8/10 cents, 13 cents, 16 cents, 17 cents, 17 cents, 34 cents, 37 cents, 37 cents and 38 cents.

Sales values are from $2.64 to $3.20 per ton, and costs vary from $2.38 to $3.29 per ton.

The labour percentage, including compensation, increases by 4 per cent to 61 per cent of the total cost.

Man-day production remains constant, with all companies producing over 3 tons per day. The highest recorded is 4.6 tons and the lowest is 3 tons per man-day over these four years.

Taxes and rentals amount to 6.4 cents, royalties to 5 cents, compensation to 9 cents, and administration to 20 cents. Depreciation charged is equal to 20 cents per ton.

Income taxes paid amount to $444,152.53, the equivalent of 4.4 cents per ton.

ALBERTA—DRUMHELLER FIELD

	Tonnage	Net Result	
Ten companies	2,974,730	$ 320,606.08	profit

Profits shown by the operators in this area amount to 1.3 cents, 1.6 cents, 2.8 cents, 3.1 cents, 3.6 cents, 9.2 cents, 9.8 cents, 10.7 cents, 18.6 cents and 54.5 cents per ton in this period.

Selling prices are down when compared with the previous period, with a low realization of $2.30 and a high of $2.88 per ton. Costs are correspondingly decreased to a range of from $2.22 to $2.94.

Labour and compensation increased by 6 per cent to 62 per cent of the total cost.

Generally, all companies show a higher man-day production, which varies from a low of 3.3 tons to 6 tons.

ALBERTA—EDMONTON DISTRICT

	Tonnage	Net Result	
Three companies	568,911	$ *19,245.58*	*loss*
Two companies	494,317	$ 10,636.17	profit

These mines continue to show very small returns, with 2 having earnings of 1 cent and 2.8 cents per ton while the other 3 sustained losses.

In commom with other mines, the sales return per ton drops during these years to a low of $1.78, with a high of $2.27. Costs remain on practically the same level as the 1930-1935 period, with a consequent decrease in profits.

Labour and compensation dropped 3 per cent, to 65 per cent of the total cost.

ALBERTA SUNDRY FIELDS	Tonnage	Net Result	
Three companies	352,604	$ *101,545.15*	*loss*
One company	1,011,182	$ 162,419.16	profit

The profitable company in this group is a continuation of other previously operating companies, figures for which your Commission did not receive for prior periods. This company, after paying income taxes of $23,760.46, made a profit of 16 cents per ton. Selling prices average $3.11 with costs of $3.04. Production per man-day is from 3.3 to 3.5 tons.

The other three companies lost 4 cents, 42 cents and 69 cents per ton over these years. As depreciation (a non-cash item) and unpaid bond interest are charged before the losses as shown, they were able to finance their operations.

ALBERTA—STRIPPING OPERATIONS (Privately Financed)	Tonnage	Net Result	
Three companies	1,049,402	$ 239,811.97	profit
One company	17,399	$ *523.13*	*loss*

One small company started during these years and on its operation approximately breaks even.

The other three continue to earn fair returns of 10½ cents, 21.4 cents and 29 cents per ton, after the payment of income taxes.

The average selling price of all companies is $2.30 per ton, with average costs of $2.09.

BRITISH COLUMBIA—VANCOUVER ISLAND	Tonnage	Net Result	
One company	2,712,461	$ 144,261.10	profit

This company still has the highest selling price and costs of all Canadian companies, in the amounts of $4.87 and $5.00 respectively. Sundry revenue transforms the operating loss into a profit of 5 cents per ton.

A comparatively low tonnage per man-day of 1.7 tons is obtained.

Depreciation is included in costs at 22 cents per ton and administration at 43 cents.

	Tonnage	Net Result	
TOTALS—ALL COMPANIES—1936 TO 1939	46,904,619	$ 4,016,167.13	profit

Summary of Period 1936 to 1939

During this period your Commission has obtained the financial data of 49 producing companies, which have produced and sold 46,904,619 tons of coal. This figure represents 77 per cent of the total Canadian production for these years.

Of the forty-nine reporting companies—

Seven in the East record *losses* of	*$ 2,129,587.91*
Seven in the West record *losses* of	*121,313.86*
Total losses—all companies (14)	*$ 2,250,901.77*

In the eastern provinces there were—

Four companies which had average earnings of $10,000.00 or under per annum.....$	55,850.19
One company earning approximately $13,000.00 per annum..	51,730.93
One company earning approximately $25,000.00 per annum..	99,030.83
One company earning approximately $80,000.00 per annum..	327,422.92
One company earning approximately $500,000.00 per annum	2,104,921.89
Total profits—Eastern Companies (8).............$	2,638,956.76

In the western provinces of Saskatchewan, Alberta and British Columbia—

Eleven companies showing net earnings of $10,000.00 per year or under.....$	152,045.41
One company showing a net profit of $11,500.00 annually....	46,921.38
Four companies showing net profits from $20,000.00 to $25,000.00 annually.....	369,965.81
Six companies showing net profits from $25,000.00 to $40,000.00 annually.....	791,199.56
One company showing a net profit of $54,000.00 annually....	221,135.65
Two companies showing net profits from $90,000.00 to $95,000.00 annually.....	742,283.05
One company showing a net profit of $133,000.00 annually...	532,267.29
One company showing a net profit of $193,000.00 annually	772,193.99
Total profits—Western Companies (27)...........$	3,628,112.14
Total Net Profits—Eastern Companies (15).............$	509,368.85
Western Companies (34)..............	3,506,798.28
Net Profit—All Companies (49)—1936 to 1939 Period...$	4,016,167.13

PERIOD 1940-1944 (WAR)

Operating Results

An analysis of the results (by districts), together with the assistance by the Dominion Treasury, is now dealt with for the years 1940-1944:

MARITIMES— DOSCO GROUP—	Tonnage	Result before Subsidies	Subsidies and/or Provincial Assistance	Result after Subsidies
Four companies	30,226,237	$*11,674,352.26 loss*	$13,203,139.30	$1,528,787.04 profit

Results as shown are after charging bond interest and rentals to parent companies of $1,849,708.51.

OTHER NOVA SCOTIA COMPANIES—				
Seven companies	3,229,839	$291,407.81 profit	$255,931.63	$547,339.44 profit
One company...	254,259	*36,279.10 loss*	31,511.29	*4,767.81 loss*
New Brunswick companies—				
Five companies.	1,256,887	$ *60,589.00 loss*	$264,569.87	$203,980.87 profit
Two companies.	641,416	*172,978.18 loss*	124,565.72	*48,412.46 loss*
Total results— Maritimes....	35,608,638	$*11,652,790.73 loss*	$13,879,717.81	$2,226,927,08 profit

During the war years costs increased considerably over the previous period. In the Nova Scotia companies, average costs increased from 78 cents to $1.32 per ton on a rising scale each year. In New Brunswick the costs of three companies climbed $1.40 per ton, one company $1.31 and the other three companies between 85 cents and 90 cents per ton.

Due to wartime restrictions on price increases, there were no commensurate raises in the returns to the companies through sale of coal. The Nova Scotia companies' sales values average from 27 cents to 88 cents more than the previous period. New Brunswick averages 90 cents per ton more. In the detailed analysis of districts, certain specific factors in this connection are dealt with.

The percentage of labour cost rose from 2 to 4 per cent when compared with the total cost. Most companies show a drop in man-day production, one as high as one ton per day from the 1939 year.

Sundry costs increase proportionately over the normal period. Taking all companies together, compensation increased by 3 cents and administration by 5 cents. Labour and material account for the major increase in costs. In one company they increase by as high as $1.08 per ton on the period average.

During this period total income taxes set up as payable in the books amounted to $1,399,009.12.

SASKATCHEWAN COMPANIES	Tonnage	Result before Subsidies	Subsidies and/or Prov. Assistance	Result after Subsidies
Three companies...	2,198,043	$ *25,953.46 loss*	$ 222,509.09	$ 196,555.63 profit
One company......	3,879,120	477,131.90 profit		477,131.90 profit

In the Saskatchewan field the average sales realization dropped to $1.25 per ton, with costs decreasing to $1.18. These four companies are mainly stripping companies, with one having in addition an underground mine.

ALBERTA AND EASTERN BRITISH COLUMBIA—BITUMINOUS—	Tonnage	Result before Subsidies	Subsidies and/or Prov. Assistance	Result after Subsidies
Eight companies	18,514,651	$4,910,118.88 profit		$4,910,118.88 profit
Two companies	3,068,555	272,126.71 profit	$ 195,624.54	467,751.25 profit

One company received a grant of $40,000 from the Emergency Coal Production Board in respect of new development, and the balance of the subsidy is in connection with an operating loss suffered by another company in 1942/1943.

Profits were made per ton by these companies in the amounts of 8.9 cents, 10.4 cents, 17 cents, 18.1 cents, 19.3 cents, 20.2 cents, 21.4 cents, 29.1 cents, 36.5 cents, and 53.6 cents, over the five-year period.

Average sales for all companies increased by 32 cents and costs by 24.6 cents per ton, when compared with the 1936–1939 period.

The labour and compensation percentage increased by a further 4 per cent during this period.

A comparison of the 1939 and 1944 man-day production for each company is as follows:

1939	1944	Profit in 1940–1944 Period		1939	1944	Profit in 1940–1944 Period	
		Increased	Decreased			Increased	Decreased
Tons	Tons	Cents	Cents	Tons	Tons	Cents	Cents
4.3	3.8		5.4	3.4	2.7		37.9
3.8	3.5	5.0		3.1	4.3	37.7	
3.4	2.8		17.6	3.3	3.5		41.2
4.6	3.7	18.6		3.7	3.3		64.1
3.6	3.5		17.7				

ALBERTA—DRUMHELLER FIELD	Tonnage	Result before Subsidies	Subsidies and/or Prov. Assistance	Result after Subsidies
Six companies....	4,137,855	$ 880,375.93		$ 880,375.93 profit
Three companies..	1,919,596	$ *85.20 loss*	$ 89,721.04	$ 89,635.84 profit
One company.....	434,180	$ *142,496.31 loss*	$ 75,096.98	$ *67,399.33 loss*

One company, after subsidies, shows a loss of 15½ cents per ton. The three companies which received subsidies showed a profit thereafter of 1/10 cent, 2 cents and 14½ cents. Profits earned by the remaining six were 9.8 cents, 19.2 cents, 19.4 cents, 19.9 cents, 20.8 cents and 51.5 cents per ton.

Selling prices, on the average, increased by 48 cents per ton, or 18 per cent, when compared with the standard period. Costs were up by 42 cents, or an increase of 16 per cent.

Labour and compensation costs were up by 2 per cent to 64 per cent of the total cost.

In the first year of this period production per man-day varied between 2.9 and 6.4 tons, and in 1944 between 2.6 and 4.4 tons.

Income taxes to the equivalent of 6 cents a ton, or $391,482.56, were charged to profits during this period.

ALBERTA—EDMONTON DISTRICT	Tonnage	Result before Subsidies	Subsidies and/or Prov. Assistance	Result after Subsidies
Seven companies..	1,942,192	$ *162,963.33 loss*	$ 247,228.39	$ 84,265.06 profit

All of these companies were in receipt of subsidies during the war years, and show profits ranging from 1.6 cents to 12.8 cents per ton after subsidies.

Income taxes were paid totalling $16,785.89.

Production per man-day declines during this period. For the year 1944 two companies' production was 3.5 and 3.9 tons, while the others were under the 3 ton production level.

Selling values increased by 42 cents per ton to an average of $2.52, and costs increased by 47 cents to $2.64 per ton. After sundry revenues of 4.7 cents and subsidies of 12.7 cents per ton are credited, over-all profits of 4.4 cents were shown.

ALBERTA—SUNDRY FIELDS	Tonnage	Result before Subsidies	Subsidies and/or Prov. Assistance	Result after Subsidies
Three companies..	611,738	$ *149,256.42 loss*	$ 151,917.46	$ 2,661.04 profit
One company.....	1,662,203	$ 234,125.37 profit		$ 234,125.37 profit

The profitable company in this group, without subsidy, earns a net profit of 14 cents per ton, after payment of $115,728.02 in income taxes. Its realization is $3.50 per ton, with costs of $3.44.

Production per man-day is from 3 to 3½ tons.

Losses are shown in two cases of 7½ cents and 9 cents per ton, and in the other a profit (after subsidy) of 8 cents.

ALBERTA—STRIPPING OPERATIONS (privately financed)	Tonnage	Result before Subsidies	Result after Subsidies
Five companies................	2,157,302	$ 488,186.07 profit	$ 488,186.07 profit

After the payment of income taxes totalling $268,963.55, these companies earned profits of $488,186.07, which is the equivalent in cents per ton of 10½, 15½, 22½, 22.7 and 27.4.

The selling value increased by 15 cents to 30 cents per ton over the preceding period, and in two cases the costs decreased by 5 cents and 6 cents per ton, with the others having increased costs of 15 cents to 25 cents.

The stripping companies financed by the Emergency Coal Production Board are dealt with separately in this report.

BRITISH COLUMBIA—VANCOUVER ISLAND	Tonnage	Result before Subsidies	Subsidies and/or Prov. Assistance	Result after Subsidies
One company..............	3,217,674	$117,242.21	$311,032.29	$428,274.60 profit

In the latter years of this period production per man-day increased, and was 2.2 tons in 1944.

Costs continued high at $5.69, with selling prices averaging $5.48.

Sundry revenue of 30 cents was earned during these years, which was sufficient to allow this company to show a profit before government assistance.

Depreciation is included at 32.6 cents and administration at 41 cents.

TOTALS—	Tonnage	Result before Subsidies	Subsidies and/or Prov. Assistance	Result after Subsidies
All Companies—1940–1944 Period.......	79,351,747	$*4,754,238.38 loss*	$15,172,874.70	$10,418,609.32 profit

Summary of Period 1940-1944

For these years your Commission has been presented with the financial data of 60 companies producing coal in Canada, and the undernoted tabulation summarizes the results of their operations, both before and after subsidies from the Emergency Coal Production Board.

Of the 60 companies whose data have been submitted:

EASTERN COMPANIES	Result before Subsidies	Subsidies and/or Provincial Assistance	Result after Subsidies
Four companies show losses, both before and after subsidies	$ *2,158,812.28 loss*	$ 1,890,236.33	$ *268,575.95 loss*
Eight companies show losses before subsidies and provincial government assistance, but profits after subsidies	*10,135,934.17 loss*	11,705,506.55	1,569,572.38 profit
Six companies show profits both before and after subsidies	487,098.54 profit	283,974.93	771,073.47 profit
One company, which did not receive any assistance, showed a profit of	154,857.18 profit		154,857.18 profit
Total Results—Maritime Companies (19)	$*11,652,790.73 loss*	$13,879,717.81	$ 2,226,927.08 profit
Of the total assistance shown above, there was provided by the Province of Nova Scotia the sum of		$ 313,551.87	
And by the Dominion of Canada		13,566,165.94	

WESTERN COMPANIES—COMPANIES RECEIVING SUBSIDIES	Result before Subsidies	Subsidies and/or Provincial Assistance	Result after Subsidies
Four companies suffered losses both before and after subsidies	$ *300,229.26 loss*	$ 208,693.85	$ *91,535.41 loss*
Ten operators show losses before subsidies but profits after	*246,210.27 loss*	543,645.05	297,434.78 profit
Six companies show profits before and after subsidies	455,053.73 profit	540,790.99	995,844.72 profit

In reviewing the immediately foregoing figures, it must be remembered that the period deals with the years 1940-1944, while the Emergency Coal Production Board assisted coal companies from 1942 on and dealt with each year on its individual merits.

WESTERN COMPANIES—COMPANIES NOT RECEIVING SUBSIDIES	Result before Subsidies	Subsidies and/or Provincial Assistance	Result after Subsidies
Two showed annual profits of under $10,000.00	$ 38,097.97 profit		$ 38,097.97 profit
Nine showed annual profits of from $10,000.00 to $50,000.00	1,248,943.51 profit		1,248,943.51 profit
Five showed annual profits of from $50,000.00 to $75,000.00	1,233,984.80 profit		1,233,984.80 profit
One showed annual profits of $95,000.00	477,131.90 profit		477,131.90 profit
Three showed annual profits of from $100,000.00 to $200,000.00	2,181,659.06 profit		2,181,659.06 profit
One showed annual profits of $360,000.00	1,810,120.91 profit		1,810,120.91 profit
TOTAL RESULTS—WESTERN COMPANIES (41)	$ 6,898,552.35 profit	$ 1,293,129.89	$ 8,191.682.24 profit
TOTAL NET RESULTS—			
Eastern Companies (19)	$*11,652,790.73 loss*	$13,879,717.81	$ 2,226,927.08 profit
Western Companies (41)	6,898,552.35 profit	1,293,129.89	8,191,682.24 profit
TOTAL—ALL COMPANIES (60) 1940–1944 PERIOD	$ *4,754,238.38 loss*	$15,172,847.70	$10,418,609.32 profit

Emergency Coal Production Board

Under the impact of war and consequent demand for increased production, the average annual production of most companies surveyed increased over the immediately prior period of 1936-1939.

To further stimulate the coal production, the Dominion Government under P.C. Order No. 10674 set up the Emergency Coal Production Board on 23rd November, 1942, as an emergency measure during the war years.

The Board was empowered to assist the presently existing companies by loans for machinery, equipment, development, retroactive wage increases, housing and for operating expenses. Additional assistance was given by grants for direct development, wage equalization and subsidies to increase production.

As an emergency measure, new stripping operations were completely financed by federal money.

On the facing page is a summary of the Board's financial transactions to 31st March, 1946.

The Board has advanced $5,101,468.06 by way of loans, of which $4,899,431.76 was interest-bearing and $202,036.30 without interest. Including outstanding interest, there is owing to the Board $2,117,880.78, which includes $282,578.52 in loans which were past due at the above date.

EMERGENCY COAL PRODUCTION BOARD

BALANCE SHEET AS AT 31st MARCH, 1946

ASSETS

Loans—Interest Bearing—			
Retroactive Wage Increase	$ 46,873.76		
Less Recovered	*45,171.70*	$ 1,702.06	
Machinery and Equipment	$ 388,800.33		
Less Recovered	*186,784.17*	202,016.16	
Development Expense	$ 35,125.73		
Less Recovered	*3,469.00*	31,656.73	
Housing	$ 16,319.81		
Less Recovered	*2,767.64*	13,552.17	
Stripping	$ 4,417,454.78		
Less Recovered	*2,686,164.07*	1,731,290.71	
			$ 1,980,217.83
Loans—Non-Interest Bearing—			
Machinery and Equipment	$ 72,953.62		
Less Recovered	*30,331.04*	$ 42,622.58	
Housing	$ 129,082.68		
Less Recovered	*34,042.31*	95,040.37	
			137,662.95
			$ 2,117,880.78
Deferred Charges—			
Production Subsidy Advances	$ 7,883,684.34		
Production Subsidy Claims Finalized	14,837,436.61	$22,721,120.95	
Grants—Capital Subsidies			
Direct			
Development.....$341,950.58			
Less Recovered *257.18*	$ 341,683.40		
Housing	9,590.15	351,273.55	
Wage Equalization		685,699.65	
Sundry Charges	$ 61,233.22		
Less Recovered	*44.12*	61,189.10	
			23,819,283.25
			$25,937,164.03

LIABILITIES

*Department of Reconstruction and Suppl*y

Receiver General of Canada—			
Open Accounts	$ 5,101,468.06		
Less Recovered	*2,988,729.93*	$ 2,112,738.13	
Interest on Loans	$ 90,440.11		
Less Remitted	*85,297.46*	5,142.65	
			$ 2,117,880.78
Appropriations—"Miscellaneous War Expenses"—			
War Appropriations—1942/1943		$ 436,940.00	
War Appropriations—1943/1944	$ 4,955,581.91		
Less Recovered	*22,682.54*	4,932,899.37	
War Appropriations—1944/1945	$ 8,482,145.44		
Less Recovered	*9,460.99*	8,472,684.45	
War Appropriations—1945/1946	$ 9,978,037.89		
Less Recovered	*1,278.46*	9,976,759.43	
			23,819,283.25
Deferred Liability—			
Adjustment Reserve—			
Acadia Coal Company Limited		$ 6,250.05	
Balance of Loan and Grant Commitments		27,168.84	
		$ 33,418.89	
Contingent Liability—			
Bank Loans Guaranteed—			
Standard Coal Company Limited, N.S.		$ 7,000.00	
Oliver Coal Mines		3,350.00	
		$ 10,350.00	
			$25,937,164.03

A further analysis of these loans (by provinces) showing interest and repayments is as follows:

—	Amount Advanced	Interest Charged	Repayments		Balance Outstanding 31st March, 1946
			Principal	Interest	
	$	$	$	$	$
Interest-bearing Loans—					
Province of					
Nova Scotia	17,502.71	535.76	17,502.71	535.76	....
New Brunswick	24,719.65	767.04	23,996.03	750.21	740.45
Saskatchewan	217,735.14	9,299.32	132,099.53	9,217.38	85,717.55
Alberta	207,828.42	6,011.04	61,871.19	4,727.23	147,241.04
British Columbia	17,723.05	928.69	2,723.05	700.61	15,228.08
Stripping Operations—					
New Brunswick	14,000.00	1,039.93	5,833.30	1,039.93	8,166.70
Alberta	4,399,922.79	71,858.33	2,680,330.77	68,326.34	1,723,124.01
Total	4,899,431.76	90,440.11	2,924,356.58	85,297.46	1,980,217.83
Non-interest-bearing Loans—					
Province of					
	$	$	$	$	$
Nova Scotia	17,303.65	....	7,336.33	....	9,967.32
New Brunswick	14,994.66	....	3,640.88	....	11,353.78
Saskatchewan	47,122.98	....	....	....	47,122.98
Alberta	122,615.01	....	53,396.14	....	69,218.87
Total	202,036.30	....	64,373.35	....	137,662.95
Grand Total	5,101,468.06	90,440.11	2,988,729.93	85,297.46	2,117,880.78

NOTE.—On asset side of Balance Sheet (previous page) total amounts advanced include interest charged and not paid. Total of amounts advanced, therefore, include $5,142.65 representing difference between interest charged of $90,440.11 and payments received of $85,297.46.

In addition to the loans, the statement also shows the amounts the Board has expended on production subsidies, grants, wage equalization and sundry charges, to a total amount of $23,819,283.25. These monies were obtained from Parliament under appropriations of the Department of Reconstruction and Supply "Miscellaneous War Expenses". By provinces these items are segregated as follows:

Province	Production Subsidies		Grants	Sundry Items	Total	Per-cent-age
	Finalized	Advances	Develop-ment, etc.			
	$	$	$	$	$	%
Nova Scotia	11,856,702.33	6,537,897.14	....	34,468.12 Audit	18,429,067.59	77.4
New Brunswick	648,925.33	170,452.93	1,805.30	1,333.47 Audit	822,517.03	3.5
Saskatchewan	298,748.35	82,505.19	75,889.80	....	457,143.34	1.9
Alberta	1,652,675.52	542,618.28	167,807.55	4,915.68 Audit	2,368,017.03	9.9
British Columbia	380,385.08	550,210.80	33,311.99	....	963,907.87	4·0
Sundry Items— rents, etc	....	....	72,458.91	20,471.83	92,930.74	0.4
	14,837,436.61	7,883,684.34	351,273.55	61,189.10	23,133,583.60	97.1
	($22,721,120.95)					
Nova Scotia—Wage Equalization					685,699.65	2.9
Grand Total of Expenditures other than loans					23,819,283.25	100.0

A further analysis of the expenditures (by years) is as follows:

—	1943	1944	1945	1946	Total
	$	$	$	$	$
Production Subsidies	429,240.00	4,211,574.64	8,298,182.85	9,815,232.15	22,754,229.64
Less Recovered	....	*22,415.36*	*9,420.87*	*1,272.46*	*33,108.69*
	429,240.00	4,189,159.28	8,288,761.98	9,813,959.69	22,721,120.95
Wage Equalization	....	449,890.75	83,986.89	151,822.01	685,699.65
Grants	....	275,926.91	68,526.85	7,086.97	351,540.97
Less Recovered	....	*267.18*	....	....	*267.18*
	....	275,659.73	68,526.85	7,086.97	351,273.55
Loans with Interest	7,700.00	669,624.41	2,010,218.40	2,217,031.60	4,904,574.41
Less Recovered	....	*5,631.31*	*833,837.59*	*2,084,887.68*	*2,924,356.58*
	7,700.00	663,993.10	1,176,380.81	132,143.92	1,980,217.83
Loans without Interest	....	134,817.08	69,577.21	31,455.27	235,849.56
Less Recovered	....	....	*63,921.40*	*34,265.21*	*98,186.61*
	....	134,817.08	5,655.81	*2,809.94*	137,662.95
Sundries	....	25,889.61	31,448.85	3,894.76	61,233.22
Less Recovered	....	....	*40.12*	*4.00*	*44.12*
	....	25,889.61	31,408.73	3,890.76	61,189.10
Grand total of balances	436,940.00	5,739,409.55	9,654,721.07	10,106,093.41	25,937,164.03

A review of the operations of the Board is fully covered in the chapter Government in Relation to the Industry.

Ancillary Operations of Coal Companies

A very large proportion of the revenue of most companies is derived from sources other than the actual mining of coal.

Over the fifteen-year period the combined net earnings on coal mined of all companies amounts to $790,088.35, or one-half cent per ton on all coal sold. From other sources the coal companies earned $21,671,440.72, or 12 cents per ton.

These sundry revenues arise from the operation of light and water utilities, through rentals of buildings, apartments, houses and hotels, sale of foreign coal, production of coke, briquettes and by-products, and from investment earnings.

Revenues included under this heading, however, are definitely connected with, and are attributable to, the coal operation, as they emanate from the townsites in which the mines are located and from the investment of reserve and surplus funds set aside or earned throughout the history of the companies.

A segregation of these earnings is as follows:

—	1930–1935	1936–1939	1940–1944
Eastern Companies	$3,274,984.39	$1,345,959.36	$5,070,944.35
Cents per Ton	10.4	5.0	14.2
Western Companies	$3,962,145.75	$2,855,995.33	$5,161,411.54
Cents per Ton	17.0	14.2	11.8
Total	$7,237,130.14	$4,201,954.69	$10,232,355.89
Cents per Ton	13.2	9.0	12.9

Included in the sundry revenues of Dominion and Cumberland Coal Companies are cost-of-living bonus and levelling of wages assistance from the Dominion Government of $1,302,075.58, which represents 3.6 cents per ton over the 1940-1944 period.

Returns to Investors

Common and/or Preferred Shares

The dividend-paying record of the individual companies is shown on the company statements. Out of the companies examined approximately 50 per cent have paid dividends, and over the fifteen-year period the amount of $17,852,006.20 was paid as follows:

Companies	Capital	Dividends Paid
	$	$
Western Bituminous	24,886,696	12,332,041
Maritimes	25,764,141	4,406,532
Alberta Domestic	5,486,473	776,183
Vancouver Island	4,627,940	nil
Saskatchewan	2,012,719	41,250
Alberta Stripping (private companies)	1,619,000	296,000
	64,396,969	17,852,006

Bondholders

There have been several of the companies which financed the original plant and working capital by the sale of bonds and debentures to the public. The proceeds from the sale of this class of security has also been used to finance further development after operations have been commenced.

The amounts charged to operations for the interest on their funded debt, together with repayment provision, are as follows:

—	Interest	Rate of Interest	Sinking Fund
	$	Per cent	$
DOMINION COAL COMPANY LIMITED—			
First Mortgage Bonds	2,756,493.35	3½, 4½, 5	2,116,333.36
Income Bonds	1,608,195.87	6	163,333.33
Equipment	141,841.73	3½, 4, 4½	582,416.67
Discount	309,148.79		
	4,815,679.74		2,862,083.36
OLD SYDNEY COLLIERIES LIMITED	1,340,233.37	5, 6	
The above represents a part of the interest on debentures of Nova Scotia Steel and Coal Company Limited, which was settled under a plan of re-organization in 1938 by the issue of Dosco "B" shares.			
CUMBERLAND	1,296,735.41	5	210,000.00
MANITOBA AND SASKATCHEWAN COAL COMPANY LIMITED	127,730.00	4½	
ALEXO COAL COMPANY LIMITED	17,820.00	6	
Over the fifteen-year period interest was waived for ten years.			
BIG HORN AND SAUNDERS CREEK	237,702.62	8 reduced to 2	
The above represents interest set up 1930-1944 but of which only $12,000.00 was paid, being the last three years at 2 per cent per annum.			
CANADIAN COLLIERIES (DUNSMUIR) LIMITED	593,006.00	7	
	596,458.65	5	
Discount	16,134.11		
	1,205,598.76		
TOTAL BOND INTEREST AND SINKING FUND	9,041,499.90		3,072,083.36

Rentals payable to parent companies are also included in the results, as follows:

	$
Old Sydney Collieries Limited	463,918.30
Cumberland Railway and Coal Company (To Dominion Steel and Coal Corporation)	399,071.60
Regal Coal Company Limited, Drumheller	832,183.24
Total Rentals	1,695,173.14

The rental of $222,736.05, paid by Cumberland Coal Company to Dominion Coal Company Limited for the years 1940-1942 is not included in the above rentals, as it is charged in costs, under the heading of "Taxes and Rentals".

Depletion

The amounts which are charged by a number of coal-producing companies in their mining costs for depletion do not represent out-of-pocket expense, but rather an amount which has been allowed by the Income Tax Department as a charge against the taxable income of the company. The Income Tax Department allows the amount of 10 cents per short ton (2,000 lbs.) on coal produced, regardless of the cost or book value of the coal areas or leases. It is not a requirement of that Department that the amount of depletion be recorded in the books of account, so that in many instances differences will be noted between the profit and loss in respect of the year's operation and the taxable income for the same year; such differences being, in the main, that the taxable income has been reduced by the depletion allowance.

The Emergency Coal Production Board, however, has only allowed as an expense for subsidy purposes, depletion on coal areas or leases where the company is able to satisfy the Board that the leases were acquired for cash.

In the subsidy claims for most companies the Board has disallowed any charge for depletion because of their inability to establish to the satisfaction of the Board a cash value for their leases.

As mentioned previously, the Income Tax Department allows 10 cents per short ton for depletion, although no expenditures have been made, and therefore, this allowance should be regarded as a risk profit which is given to the companies to compensate in some measure, the hazards of the industry and for the purposes of income tax.

Conclusions

The foregoing general review, supplemented as it is with related material on most of the mining companies in Canada, clearly indicates that the operations of the industry as a whole have not been too profitable. Involving an investment which at the end of 1944 amounted to approximately $83,000,000 and in respect of sales of 180,000,000 tons over the fifteen-year period, the Canadian coal industry has had a return of approximately 10 cents per short ton. While this is the over-all result, a geographical distribution of these figures shows that the eastern companies (Maritimes) sold 52 per cent of the coal and only made a net profit of $\frac{1}{3}$ cent per ton, while the western companies (Saskatchewan to British Columbia) sold 48 per cent of the coal and realized a profit of $19\frac{1}{2}$ cents per ton. These figures are before any provision for depletion.

The foregoing results are after including production subsidies paid by the Emergency Coal Production Board and other governmental assistance totalling approximately $15,000,000, of which approximately $13,800,000 was paid to the eastern companies and $1,200,000 to the western companies. If the operating results are considered before the application of the above subsidy amounts, the

operations of the eastern companies would have resulted in a loss of 14½ cents per ton while the profits of the western companies would have been reduced to 18 cents per ton. It is only fair to observe that subsidies paid by the Emergency Coal Production Board were in considerable measure due to the wartime price ceiling policy.

The most important yardstick for ascertaining the cost per ton is the man-day production, and it will be appreciated that the larger man-day production as experienced by the western mines is the main contributing factor to the drastically different operating results. It will also be recalled that the same observation is true, insofar as man-day production is concerned, as between mines in the same area. A review of the importance and significance of this vital matter is contained in the chapter on "Mining Methods".

A very general review, therefore, of the industry in different areas will indicate that, as mentioned previously, the western companies have had a favourable operating experience, the most satisfactory of which was enjoyed by the bituminous operators in Alberta and Eastern British Columbia. The record of the domestic mines in Alberta is varied, as the analysis will show that some have carried on with marked success while the record of others is quite indifferent.

Canadian Collieries (Dunsmuir) Limited, the major producer in British Columbia, has had only a fair operating record. The operations of only one company in the Nicola-Princeton field have been reviewed, but the record of mining companies in that area over a long period of years has been unfavourable. Saskatchewan operations, on the whole, have progressed, the major operator carrying on strip mining and although receiving production subsidy during the war period can be regarded as a successful operation.

Minto operations in New Brunswick, carried on to meet a localized demand, received only limited assistance by way of transportation subventions. During the war period, however, all of the companies in this field have received financial assistance by way of production subsidies from the Emergency Coal Production Board.

The operations in Nova Scotia have particularly required the assistance of transportation subventions, and the amount expended in this connection is dealt with in a separate chapter on that subject. The war produced many conditions that were particularly difficult for Nova Scotia. Their cost of production was always high but was neutralized to some extent by the low cost of using the St. Lawrence Waterway to eastern markets. Their difficulties, therefore, became quite pronounced when the exigencies of war precluded that traditional movement of their coal.

Varying difficulties attend coal mining in each district and quite often in each mine, and therefore a full understanding of the many problems can only be obtained by correlating this financial review with the problems which are fully canvassed in other chapters of this Report.

CHAPTER V

INDUSTRIAL RELATIONS

This chapter deals with the miners, the conditions under which they live and work and the human side of a number of technical problems, as well as with the relations of the miners with their employers. In brief, the term industrial relations is used in its broadest sense. The first section of the chapter describes the miners and their living and working conditions and the second outlines the major problems of industrial relations in the industry.

THE MINERS

Locations, Origins and Family Circumstances

About 25,000 men earn their living in Canada getting coal out of the ground and started on its way to market. About half of them are in Nova Scotia, a third in Alberta, and the balance in British Columbia, New Brunswick and Saskatchewan. Ninety-five per cent of the mine workers belong to the United Mine Workers of America and there are a few small independent unions at individual mines.

These men work for some 350 operators, of whom in 1944, 196 were in Alberta, 89 in Saskatchewan, 26 in British Columbia, 19 in New Brunswick and 19 in Nova Scotia. The number of bargaining units on the employers' side is however considerably smaller than these figures would indicate, as in the major areas the operators are associated for various purposes including collective bargaining.

Substantial differences stand out as between coal mining in eastern and in western Canada. The nature of the coal deposits, the organization of mining, backgrounds of the miners and the histories of industrial relations are all different. The people of the mining communities in the two regions, and the mine operators, have different attitudes to similar problems. Even in the United Mine Workers of America, which might at first sight appear to be one standardizing element in the industry, substantial differences exist between East and West. District 26 (Maritime Provinces) and District 18 (Western Canada) both subscribe to the general constitution of the U.M.W.A. They are otherwise completely independent of one another, and their policies and attitudes diverge substantially. For instance, District 26 urged nationalization before this Commission as the only solution to the problem of the coal miners in that area; District 18 approved maintenance of the private ownership of coal mining operations, and stated its general satisfaction with existing industrial relations.

Part of the difference in the attitudes of the miners is a difference of background. The Maritime miners, and particularly those of Cape Breton, have long associated in the same communities, and have a strong tradition of local pride. Most of them are descendants of settlers who came in the eighteenth and nineteenth centuries from the British Isles. Four-fifths of the men employed in the coal mining industry of Nova Scotia at the time of the 1941 census were born in Canada, and 14 per cent in the British Isles. Three-quarters of them had always lived in Nova Scotia, and virtually all the rest had been there for over ten years. Since the West was not opened up for general settlement until the late nineteenth and early twentieth centuries, the mining population does not have the long community traditions, the similarity of background or the same degree of attachment to locality that characterize the Maritime

mining areas. Half of the Alberta miners were born in Europe, 21 per cent in the British Isles, 4 per cent in the U.S.A., and only about 25 per cent in Canada. Only 15 per cent of the mine workers have lived all their lives in Alberta, although 81 per cent have been there over ten years.

These facts are not noted with any intention of disparaging the more recent arrivals. They do perhaps help to explain why the Maritime miner appears to be more reluctant than his western counterpart to leave his own immediate district in search of other employment. In the West, not only are there more coal fields for a man to seek work in, and possibly better opportunities for alternative employment, but the western miner also appears to be less reluctant to change his place of residence.

Similar differences appear between East and West with regard to marital and parental status. Larger proportions of miners in Nova Scotia than in Alberta are married and have children, and the average number of children per family is higher. Thus the Nova Scotian is more likely to have family ties which make it difficult for him to move when his job vanishes or is unsatisfactory to him.

The following table, drawn from 1941 census data, indicates the situation in the coal producing provinces as to natal origin, marital and parental condition, and home ownership of mine workers.

—	Nova Scotia	New Brunswick	Saskatchewan	Alberta	British Columbia
Birthplace—					
Canada........Per cent	79	83	39	25	27
British Isles........Per cent	6	5	16	21	38
Other........Per cent	15	12	45	54	35
Residence in Province—					
Always........Per cent	74	70	26	15	20
10 years and over........Per cent	99	93	94	96	93
Heads of Families........Per cent	70	57	65	61	62
Families with Children........Per cent	83	81	78	77	72
Average Number of Children (All Families)........	2.8	2.6	1.7	1.8	1.6
Householders Owning Homes...Per cent	55	49	36	63	56

Census data indicate a marked decline since 1921 in the proportion of men under 35, and a marked increase in the proportion of men 45 and over. For instance in 1921, 55 per cent of the mine workers in both Nova Scotia and Alberta were under 35; in 1941 the proportion was only 41 per cent in Nova Scotia and 26 per cent in Alberta. The greater part of this decrease occurred in the decade between 1931 and 1941. The proportion of older men rose accordingly: whereas in 1931 the proportion of men over 45 was 29 per cent in Nova Scotia and 28 per cent in Alberta, in 1941 it was 37 per cent in Nova Scotia and 46 per cent in Alberta. This increase in the proportion of older men is significant in relation to productivity, and also has an influence upon the attitude of the men toward change in their working and social organization.

Part of this trend was a result of the depression of the 1930's, when the labour force diminished and there was little recruitment. Part of it was also due to heavy enlistments from among the physically fittest miners and to the curtailment of the normal entry of young men into the mines because of enlistments and the increased availability of other employment. It is probable that the average age of the men in the mines increased after 1941.

Their Unions

The long and troubled history of collective organization of mine workers in Canada affects present labour-management relationships. Members of the U.M.W.A. face current issues conscious of the struggles and dissensions which have endangered their union in the past. Management remembers by what steps the union grew. Contract negotiations and daily relations alike are influenced by the past.

Labour Organization—The Past

Nova Scotia

The first coal miners' union in Canada was formed in 1879 at Springhill, Nova Scotia, when the employees of the Cumberland Railway and Coal Company organized the Provincial Workmen's Association to resist a proposed wage cut. The miners were successful. Lodges of the Association were promptly established at Westville and Stellarton in Pictou County, but it was not until 1887 that the Association succeeded in organizing the mine workers of Cape Breton. It sought to secure a peaceful settlement of disputes, and supported compulsory arbitration. In 1888 the principal demands placed by the P.W.A. before a Nova Scotia Royal Commission on Labour were for a legal minimum age of twelve years for mine workers, tests of physical fitness and literacy, an apprenticeship system and mining schools. The loss of a steel strike at Sydney in 1904 and the acceptance by the union executive of wage adjustments proposed in 1908 by a Federal conciliation board encouraged dissatisfaction among the membership of the Association. This assisted the growth of the United Mine Workers of America.

In 1908 the U.M.W.A. was the recognized bargaining agent for over half the men producing bituminous coal in the United States, and since 1903 had been active in western Canada. In December, 1908, the first U.M.W.A. local in the Maritimes was established at Springhill, Nova Scotia, and in the early part of 1909 Nova Scotia was designated District 26 of the U.M.W.A. Shortly afterwards the Provincial Workmen's Association took a referendum vote on the question of affiliation or amalgamation with the U.M.W.A., the result being 2800 votes in favour and 2400 against. The referendum was overruled by the Grand Council of the Provincial Workmen's Association and the question of affiliation remained unsettled.

The Nova Scotia coal operators opposed the U.M.W.A., on the grounds that it included in its membership the lower grades of officials and that it was a foreign organization. The P.W.A., being only a provincial organization, was financially weak in comparison to the U.M.W.A., and consequently less able to endure a long strike and less able to make a strong stand against the operators on any issue.

During 1909 strikes of U.M.W.A. members, arising out of the rivalry between the unions, started at Glace Bay and Inverness on Cape Breton Island and Springhill on the mainland, and the militia was called in. The strike at Glace Bay ended in April, 1910, but Cumberland County was tied up completely until January, 1911, the strike being called off in May, 1911. At Inverness there was a two-year struggle ending in a compromise. There was no strike at Sydney Mines. Nowhere did the U.M.W.A. secure recognition by the operators as the men's bargaining agent. The use of company police, the withdrawal of maintenance men by the U.M.W.A. at some points, and violence and legal action between members of the rival unions, contributed to the bitterness against the employers and the dissension among the men which characterize industrial relations in the Nova Scotia mines.

After the strikes, the membership of the United Mine Workers of America decreased until in 1915 the Charter of District 26 was withdrawn by the International Executive. In 1916 a new organization, the United Mine Workers of Nova Scotia, was formed. Early in 1917 the United Mine Workers of Nova Scotia and the P.W.A. each applied to the Federal Minister of Labour for a conciliation board to consider labour and working conditions in the mining industry. A Royal Commission known as the Chisholm Commission was appointed, and its investigation resulted in the amalgamation of the two unions into one, the Amalgamated Mine Workers of Nova Scotia, which was recognized by the operators as the bargaining agent of the men.

In 1918 a referendum submitted to the membership of this union indicated that 98 per cent were in favour of joining the United Mine Workers of America. Following conferences of representatives of management, labour and government, the principal operators agreed to recognize the U.M.W.A. as the bargaining agent of the employees, on certain conditions, the principal ones being that the U.M.W.A. would recognize the disability of Nova Scotia coal in competition with United States coal, and never try to force Nova Scotia wages to the level paid in the United States, and that the autonomy of the Nova Scotia district within the U.M.W.A. would be maintained. The U.M.W.A. since that time has been the recognized bargaining agent of the employees in the coal mining fields of Nova Scotia, with the exception of a few small mines.

The U.M.W.A. negotiated wage increases in 1919 and 1920, the latter increase bringing rates to the highest level prior to the recent war (basic day rate $3.90). When this agreement terminated at the end of 1921, the British Empire Steel Corporation, employing about 90 per cent of the Nova Scotia mine workers, negotiated for a reduction of 33⅓ per cent, and, negotiations failing, put the reduction into effect without an agreement. The men in retaliation adopted for a time the policy of "striking on the job", now known as the slow-down. There were also acts of sabotage in the mines. During the ensuing 18 months, the recommendations of two successive conciliation boards, and two agreements tentatively reached between the operators and the union executive, were rejected by the men. In August, 1922, the men struck, and at the same time elected a new executive. The new officers instituted the "100 per cent strike", removing the maintenance men from the mines, contrary to the policy of the U.M.W.A. Mediation by the Provincial Government resulted in September, 1922, in the end of the strike and an agreement which was to run at least until January 15, 1924.

Early in 1923 the District Executive enquired of the International Executive whether affiliation with the Red International of Labour Unions would be permissible. The International Executive, which has always been opposed to revolutionary political movements, warned that such affiliation would result in the withdrawal of District 26's U.M.W.A. charter.

In July, 1923, the miners of Cape Breton and Pictou struck in sympathy with steel workers striking at Sydney. In some mines the maintenance men struck with the rest. The International President, having without effect warned that this strike was in breach of the existing contract and therefore contrary to the policies of the U.M.W.A., revoked the charter of District 26, deposed the officers, declared them ineligible for re-election, and appointed a provisional slate of officers to carry out the existing contract. In 1924 the autonomy of the District was restored and a new slate of officers elected. At the termination of the contract in January, 1924, no agreement could be reached until after a strike lasting about a month. Again at the end of the 1924 contract, no agreement could be reached and a four-month strike with outbreaks of violence ensued, the maintenance men again stopping work. Finally the Provincial Government was successful in arranging an interim contract to be in force pending a full enquiry into the coal industry of Nova Scotia.

The enquiry was conducted by the Royal Commission known as the First Duncan Commission, which recommended a 10 per cent cut from the 1924 wage level. This was made effective and remained in force until the end of 1928. Provision for profit-sharing with the employees was made in the two contracts covering the next four years, but no profits were shown.

In 1932, another Royal Commission known as the Second Duncan Commission was appointed to examine the Nova Scotia coal industry in the light of the depression conditions then prevailing, and particularly because of protest by miners and municipalities against a proposed reorganization of the Cape Breton mines which would reduce employment. The report of the Commission noted an improvement since the last enquiry in the relationship between operators and men, and approved the former's proposals for reorganization. In the same year, however, an attempt was made by a dissident faction of the men to supplant the U.M.W.A. with another union. This new organization, which took the name of the Amalgamated Mine Workers of Nova Scotia, gained some strength in Cape Breton for a time, but in 1935, its membership returned to the U.M.W.A.

The U.M.W.A. has not since been challenged by any other union and apart from a small union in the Pictou field represents all the workers in Nova Scotia mines. It has, however, had internal troubles of a serious nature. Dissatisfaction among some of the men in Cape Breton with the contract made in 1941 resulted in a slow-down which seriously reduced output and the men's earnings. The slow-down was carried out against the will of the executive and in spite of warnings from the International President that such tactics were contrary to U.M.W.A. policy. The present executive, elected in 1942, is composed largely of men who were leaders in the slow-down or the Amalgamated Mine Workers movement or both.

New Brunswick

No union was recognized as the bargaining agent of the mine workers in New Brunswick until 1938. There had been numerous unsuccessful attempts to organize unions, many of them involving strikes for recognition. In 1918 the American Federation of Labour tried to organize; in 1919 the U.M.W.A.; in 1927 the One Big Union; in 1934 the Amalgamated Mine Workers of New Brunswick; and in 1937 the U.M.W.A. again. In 1938 an independent union, the Rothwell Mine Workers Union, composed of the employees of the Rothwell Coal Company Limited, was organized and recognized by the Company as the men's agent. In 1940 the U.M.W.A. secured its first contract with a New Brunswick operator, and it now has contracts with all operators except the Rothwell Coal Company Limited.

Alberta and British Columbia

Organization of coal mine workers in the western coal fields commenced in 1900 when the Western Federation of Miners, a union operating in metal mines in the western United States, started organizing the employees of the Crow's Nest Pass Coal Company at Fernie, B.C. In 1902 and 1903 the Federation extended to the mines at Coleman and Frank in Alberta, and in 1903 it attempted to organize the Vancouver Island mines.

In the same year the Federation called a strike in both the Crowsnest Pass and Vancouver Island fields, primarily for recognition as the men's bargaining agent, but partly in sympathy with the strike of the United Brotherhood of Railway Employees against the Canadian Pacific Railway. The Federation and the United Brotherhood of Railway Employees were both constituent parts of the American Labor Union, a labour association with headquarters in Butte, Montana. Between 3,000 and 3,500 men were involved in this strike which lasted at the various mines for periods ranging from 10 days to several months. On Vancouver Island the strikes were unsuccessful, and the Western Federa-

tion of Miners lost what strength it had had there. In 1905 the Western Fuel Company, one of the principal operators on Vancouver Island, negotiated an agreement with a committee of its employees not affiliated with any outside union.

The United Mine Workers of America first entered the western Canadian coal fields in 1903, the organization in this area being set up as District 18 of the union. In the Crowsnest Pass field the Western Miners' Federation advised the men to transfer to the U.M.W.A. on the grounds that the Federation, being primarily a metal miners' union, was less able to handle the coal miners' problems than was the U.M.W.A. Between 1903 and 1905 the U.M.W.A. secured agreements with all the operators in the Crowsnest Pass field. In 1906 they organized the employees of the Galt collieries at Lethbridge and after a strike lasting from April to December secured a contract to run until March 31, 1909.

Development of the U.M.W.A. as a single organization dealing with all the operators in the Crowsnest area led to formation by seven Crowsnest operators in 1907 of the Western Canada Coal Operators' Association. In 1907 this Association signed the first collective agreement made between the U.M.W.A. and a group of coal operators in Canada. The Association and the U.M.W.A. then expanded their membership to the "domestic" coal mines in the Lethbridge and Taber fields and continued with the making of collective agreements for all the larger mines in southern Alberta.

In 1910 a local union called the Canadian Federation of Miners was organized at Cumberland and Ladysmith, British Columbia. This union is reported to have requested affiliation with the U.M.W.A.: in any case, in 1911 the U.M.W.A. began to organize the field, and in 1912 struck unsuccessfully for recognition. The field remained unorganized by a large union until 1938, although there were local unions at some Vancouver Island mines.

During World War I there was great development in mining of "steam" coal in the Brazeau and Mountain Park areas, and of "domestic" coal in the Drumheller area. Virtually all coal miners were organized by the U.M.W.A. and virtually all the operators were members of the Association. During the war the Federal Director of Coal Operations dealt among other things with labour relations, wages and prices in coal mining. Although collective bargaining was, in effect, under his control, the Western Canada Coal Operators' Association and the U.M.W.A. were recognized as representative of the operators and men respectively.

After the war many mine workers, including most of the executive of District 18 of the U.M.W.A., joined the One Big Union movement, which sought to encompass all workers of all industries and advocated fundamental changes in the organization of society. An international commission, appointed by the U.M.W.A. International Executive Board to administer the affairs of the U.M.W.A. in District 18, maintained the contract with the operators despite local strikes called by the One Big Union. In 1922 and 1924 there were prolonged strikes in opposition to wage reductions. The 1922 strike was successful in preventing a reduction at that time; the 1924 contract provided for a reduction of roughly 15 per cent instead of the 50 per cent proposed by the operators.

Following the 1924 strike the employees of the Crow's Nest Pass Coal Company at Fernie, B.C., negotiated a new agreement with that company which provided for further reductions in wages. The men withdrew from the U.M.W.A., and the Company from the Operators' Association. This break from the seventeen year old practice of maintaining a single contract for the whole District was followed by the employees at the Michel operations of the Crow's Nest Pass Coal Company, and quickly spread through the other coal fields. The U.M.W.A. signed contracts on the reduced scale with some operators

in Drumheller, the only western field in which any membership or contracts were retained. In most cases the employees at the various mines formed local unions not affiliated with any central organization.

During 1925 various local unions throughout Alberta and southeastern British Columbia grouped together as the Mine Workers Union of Canada, District No. 1. It was never successful in getting a district-wide agreement with the coal mine operators. Some time after its organization the M.W.U.C. became affiliated with the All-Canadian Congress of Labour, but in 1931 it adhered to the Workers' Unity League, which described itself as the Canadian section of the Red International of Labour Unions.

In 1932, the Edmonton field, where there had been only intermittent organization, voted to join the U.M.W.A., and some local units elsewhere withdrew their affiliation from the M.W.U.C. The two principal unions were competing quietly for prestige each with the membership of the other, with the independent local unions, and with the unorganized mine workers. In 1936 a conference, called by the Alberta Federation of Labour, and including representatives of these two unions and of unaffiliated local unions, agreed that a vote be taken by the membership of the M.W.U.C. and of local unions not affiliated with either major union on the question of rejoining the U.M.W.A. As a result of this vote all the local units of the M.W.U.C. and some independent unions were absorbed in the U.M.W.A., and in the following two years the U.M.W.A., District 18, became the bargaining agent for virtually all the mines in Alberta and British Columbia Crowsnest. In 1938 the miners on Vancouver Island were fully organized in the U.M.W.A., and after reference of a dispute to a conciliation board, the U.M.W.A. signed its first contract with Canadian Collieries (Dunsmuir) Limited, the sole remaining large operator on the Island. The interior British Columbia mines were also organized during the 1930's and now recognize the U.M.W.A. as the bargaining agent for their employees.

The Western Canada Coal Operators' Association disintegrated at the same time as the U.M.W.A. in 1925. After the reorganization of the U.M.W.A., the operators of the bituminous mines in 1937 organized the Western Canada Bituminous Coal Operators' Association including all "steam" coal operators except those at Coleman and Hillcrest, where the employees were not members of the U.M.W.A. The employees at both Coleman and Hillcrest have since become members of the U.M.W.A. and the operators have become members of the Western Canada Bituminous Coal Operators' Association. The Association since 1938 has represented the bituminous operators in negotiations with the U.M.W.A.

The "domestic" coal operators in Alberta in 1938 met jointly with the union, but negotiated contracts as individual companies without a formal organization. The Drumheller operators in 1944 organized the Drumheller Coal Operators' Association which functions like the Western Canada Bituminous Coal Operators' Association, for the negotiation of wage contracts covering the operations of the members.

Saskatchewan

The U.M.W.A. attempted unsuccessfully in 1907, 1908, and again in 1915, to organize the Saskatchewan lignite field. In 1920 the One Big Union entered the field, also unsuccessfully. In 1931 the Mine Workers' Union of Canada attempted to organize; a strike for recognition was called and during it there was rioting in which three miners were killed. The outcome was a series of agreements between operators and mine committees, or company unions, which with variations, continued in effect until 1938.

In that year the U.M.W.A. once more entered the field, and, having secured the adherence of a majority of the men, struck for recognition, the eight-hour day and a uniform contract for the field. The strike was called off to permit a Federal conciliation board to function. Protracted negotiations, interrupted by

another strike and reopened by the Saskatchewan Government, resulted in December 1939 in agreement that a new union, the Mine Workers' Central Union, would be set up to represent the employees of the various operators in the field, and would be recognized by the operators, and that the U.M.W.A. and the Canadian Federation of Labour (which had a small affiliate in the field, the Saskatchewan Coal Miners' Union) would withdraw from the field for the duration of the war, and one year thereafter. Subsequently Western Dominion Coal Mines Limited refused to accept the application of this agreement to their stripping operations at Taylorton, and the Saskatchewan Coal Miners' Union continued as the bargaining agent of the employees there. In 1945, after the end of the war in Europe, the Mine Workers' Central Union amalgamated with the U.M.W.A., which thereby became the bargaining agent for the majority of the men in the Saskatchewan mines.

Labour Organization—The Present

Of 13,400 coal miners in the Maritime Provinces, about 13,200 are members of the United Mine Workers of America; in western Canada almost 10,000 of the 11,800 coal mine employees are members. Eight small unions represent men working at mines, but their total membership is less than four per cent of such men, and includes junior officials and men employed on stripping operations as well as miners. The U.M.W.A. is recognized by the operators as the bargaining agent of the employees of all but a very few coal mines in Canada.

The principal function of the U.M.W.A. is to bargain on behalf of the men in negotiations concerning their wages and working conditions, but its objectives, as set out in the constitution of the International Union, are not limited to this:

> "First: To unite in one organization, regardless of creed, colour or nationality, all workers eligible for membership, employed in and around coal mines, coal washeries, coal processing plants, coke ovens, and in such other industries as may be designated and approved by the International Executive Board, on the American continent.
>
> "Second: To increase the wages, and improve the conditions of employment of our members by legislation, conciliation, joint agreement or strikes.
>
> "Third: To demand that not more than six hours from bank to bank in each twenty-four hours and not more than five days per week shall be worked by members of our Organization.
>
> "Fourth: To strive for a minimum wage scale for all members of our Union.
>
> "Fifth: To provide for the education of our children by lawfully prohibiting their employment until they have at least reached eighteen years of age.
>
> "Sixth: To secure equitable statutory old-age pensions, workmen's compensation and unemployment insurance laws.
>
> "Seventh: To enforce existing just laws and to secure the repeal of those which are unjust.
>
> "Eighth: To secure by legislative enactment, laws protecting the limbs, lives and health of our members; establishing our right to organize; prohibiting the use of deception to secure strike breakers; preventing the employment of privately armed guards during labour disputes; and such other legislation as will be beneficial to the members of our craft".

In addition to these formal objectives, the union carries on certain mutual benefit activities, through which Union members and their families may be assisted when in distress.

The U.M.W.A. is an international organization, in the form of a voluntary and unincorporated association. It has its headquarters in Washington, D.C., and is divided on a geographical basis into thirty districts, of which two are in Canada, District 26 covering Nova Scotia and New Brunswick, and District 18 covering Saskatchewan, Alberta and British Columbia. Each district is divided into sub-districts, and each sub-district includes a number of local unions. The

local union embraces the union membership among the employees of one or more mines. In general, each local union elects by secret ballot at intervals of two years its president, vice-president and secretary-treasurer, and its members may vote in the elections for the executives of the sub-district and district in which it is located and for the international executive. The International Executive consists of a board composed of a member elected or appointed from each district, together with the President, Vice-President and Secretary-Treasurer. Similarly there are district boards with one member elected from each sub-district*, and sub-district boards with one member from each local. The powers and duties of the executive officers and the various boards are set out in the constitution of the International Union, which can only be altered by the International Convention, or by a special referendum vote.

International conventions are held biennially or at the call of the Executive Board. Delegates to international, district and sub-district conventions are chosen by direct vote of the local unions. The International Convention is the supreme policy-making body of the U.M.W.A.; between conventions the International Executive Board, or when it is not in session, the President of the U.M.W.A., is the final authority. Locals, sub-districts and districts may make such by-laws and regulations for the government of their members as do not conflict with the constitution and regulations of the higher authorities of the organization.

This general outline of the internal government of the Union must be modified with respect to the district executives. These are of two types: those in which the district executive is elected by the membership of the local unions, and those in which the district executive is appointed by the International Executive Board. In the first case, the district is said to be autonomous. In Canada, District 26 is autonomous; District 18 is not.

The union is financed by monthly membership dues. In District 26 monthly dues are $2, of which 30 cents is retained by the local union, 80 cents by the District organization, and 90 cents paid to the International organization. In District 18 the dues vary between $1.90 and $2.25; the locals retain from 40 to 75 cents, some locals by their own decision having set up funds for such purposes as the provision of special medical services; the payment to the District organization is 60 cents, and to the International organization 90 cents. In both Districts dues are collected on behalf of the union by the operators from the wages of the individual members (the check-off), and transferred monthly to the local Secretary-Treasurer, who forwards the appropriate amount to the District and International offices. All these officials are bonded, their accounts are subject to audit, and the auditor's report is submitted to the union members.

The principal purpose of the funds so accumulated is to build up reserves against the cost of strikes, but they are also used to pay the administrative expenses of the union, and for welfare and research work. The International Union and the Canadian Districts also publish their own periodicals, and District 26 supports financially the Glace Bay *Gazette*.

The question is often asked whether the Canadian Districts draw from the International organization benefits proportionate to the dues they pay. The International Union may, by agreement, finance all or a part of the cost of a strike which is beyond the capacity of the District and local treasuries, and may also contribute to the cost of organizing in non-union fields. In District 18 the experience has been that the International Union has paid out in strike benefits and in organizing costs more than it has received from the District in dues. District 26 has had no "approved" district-wide strike since 1925, and has drawn no money from the International for that purpose in recent years;

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* In District 18 the representative of each sub-district is appointed by the District Executive.

the earlier situation was much different and substantial strike benefits were received. Financial assistance of other varieties has, however, been given District 26 by the International from time to time.

In Canada, each District organization negotiates the wage contracts for its member locals with the operators or operators' associations as the case may be, and is responsible for the maintenance of the contracts by the union members. Both are independent of the International in negotiations except for requiring its prior approval for a strike which will require financing from the International funds.

The International Executive, however, does accept responsibility for the maintenance of the contract: it will be recalled that when District 26 struck in 1923 in breach of its contract, and withdrew the maintenance men from the mines, the International President removed the District Executive from office and installed a provisional executive to maintain the contract. The International President also attempted to end the slow-down in the Cape Breton mines in 1941. In District 18, the fact that the District officers are appointed by the International Executive means in effect that the International considers itself responsible for District policies, as regards maintenance of contracts and all other matters.

The U.M.W.A. has its own system of regulations and its own means of enforcing them. Any member accused of violating any of the organization's laws may by vote of the local union be penalized by fine, debarment from union office, suspension of union membership, or expulsion from the union, subject to the right of appeal to each successive level of authority in the organization.

The Canadian Districts of the U.M.W.A. are at present affiliated with the Canadian Congress of Labour, the policies of which are framed by its Canadian members although it has an affiliation with the Congress of Industrial Organizations in the United States. In the United States the U.M.W.A. recently renewed its affiliation with the American Federation of Labor, after having left it some years ago and taken a prominent part in the development of the C.I.O.

As Subjects of Labour Laws

Government activity, Dominion and provincial, has in peacetime affected the Canadian coal miner in his work in three major respects: it has provided by legislation for his maximum hours of work, his safety and his compensation in case of accident; it has provided machinery for conciliation of his disputes with his employer; and it has provided machinery to facilitate collective bargaining with his employer. Working conditions, safety and workmen's compensation are the responsibility of the provincial governments, and both Federal and provincial legislation has from time to time provided conciliation and collective bargaining facilities.

In wartime, government intervention has gone much further; in World War I wages and working conditions in the coal mines were controlled by the Dominion, and in the second World War, these things and also the miner's liberty to leave his job and the employer's liberty to discharge him have been subject to Federal regulation. The Federal Government made its principal contribution to the development of collective bargaining during the second World War. For this Commission's purposes, however, it is the peacetime interest of government in the coal mine workers that is of primary importance.

Safety, Hours of Work, and Compensation for Accidents

Provincial safety and compensation regulations were the first activity of government to affect the miner in his work.

At Confederation, regulation of the work of miners was placed under the jurisdiction of the provinces, by Section 92 of the B.N.A. Act. The provinces in which coal mining was conducted all enacted laws regulating minimum ages and maximum hours of work in coal mines early in their development. For instance, Nova Scotia in 1873 forbade the employment of boys under ten and limited the hours of boys under thirteen to ten in a day and sixty in a week; in 1877 British Columbia imposed a minimum age of twelve for work in the coal mines and limited the hours of boys under fifteen to thirty in a week. Provisions for the health and safety of miners have been added from time to time, and are now fairly uniform in substance. These safety laws establish definite qualifications for employment in jobs involving the safety of others, and regulate such matters as standards of ventilation; use of electric power, explosives and safety lamps; standards of timbering; provision of rescue and first-aid equipment; and investigation and reporting of accidents.

Similarly, the provinces have established laws providing for the compensation of workmen in many industries, including coal mining, for accidents and certain diseases arising out of their employment, payable out of a fund collected from the operators in the industry and administered by a Provincial Board. All mine operators are required to pay to the fund a sum generally calculated as a percentage of payroll, the percentage being varied from time to time as experience indicates to be necessary to meet the cost of compensation payments incurred within the whole industry. The rate for coal mining is generally highest among industries, reflecting the dangerous nature of the work of the miners; it ranged in 1945 from 11 per cent of payrolls in Alberta to 5.25 per cent in Nova Scotia, being 6 per cent or 7 per cent in the other coal mining provinces.

Conciliation

In providing machinery for conciliation of disputes, both the federal government and the provincial governments have been active. The provinces were first in this field. In 1888 and 1890 Nova Scotia adopted laws requiring compulsory arbitration, later repealed. Most of the early provincial laws provided for conciliation, and for arbitration if agreed to by both parties.

The first Dominion legislation on the subject, the Conciliation Act of 1900 (now known as the Conciliation and Labour Act) was merely permissive. It authorized the Minister of Labour to appoint conciliation officers or a conciliation board whose services could be placed at the disposal of either or both parties to a dispute: it has proved useful both in the early stages of disputes and after a strike or lockout occurred.

A coal miners' strike in Alberta in 1907 was the immediate occasion of a further statute, the Industrial Disputes Investigation Act, which prohibited strikes and lockouts pending investigation, and which was based on the theory that informed public opinion will have beneficial effects. The Act applied directly to coal mining and certain other industries, but could apply to a dispute in any industry if both parties consented.

Under this Act (as amended) there was to be appointed on the application of either party to a dispute or at the request of a municipality or on the Minister's own initiative, a Board of Conciliation and Investigation consisting of one representative each of employers and workers and an independent chairman. If the parties agreed to be bound by the recommendation of a Board, it could be made a rule of court and enforceable; otherwise the process terminated with the publication of the report of the Board, whereupon the right to strike or lockout revived. Notice of an intended change in wages or hours was required to be given in advance, and in the event of a dispute neither party could alter the wages-and-hours conditions until the dispute had been dealt with by a Board.

In 1925 the Judicial Committee of the Privy Council held the Act ultra vires as primarily affecting "property and civil rights", a subject normally within provincial jurisdiction. The Act was therefore amended in 1925 to restrict it in the first instance to disputes in connection with works within Dominion jurisdiction and, secondly, to enable its application to disputes within the jurisdiction of any province which enacted a statute declaring the Act to apply. It was the second field which included coal mining.

Between 1925 and 1932 all the provinces, except Prince Edward Island, enacted enabling laws bringing the Dominion statute into force therein; but in 1937 British Columbia repealed its enabling Act and replaced it with an Act setting up similar provincial machinery.

Early in the recent war, under the emergency powers of the Dominion the application of the I.D.I. Act was extended to defence projects and war industries (regardless of the normal jurisdiction of the provinces) and various related matters were brought within Dominion authority by Orders in Council. In 1944, however, the I.D.I. Act and certain of these Orders in Council were suspended, and, in effect, incorporated in the Wartime Labour Relations Regulations of February 17, 1944. The Regulations cover all industries normally within Dominion jurisdiction and all war industries as therein defined. They also cover industries normally within provincial jurisdiction, any deficiencies of jurisdiction in this respect having been thought to be overcome by provincial legislation "applying" the regulations to industries within provincial authority, except as to Alberta, Prince Edward Island and Quebec, and since 1944 to Saskatchewan. Subsequent to the war these Regulations were continued under the National Emergency Transitional Powers Act. With the lapsing of this Act early in 1947 jurisdiction will revert to the provinces.

Meanwhile there are on the statute books of various of the coal mining provinces measures relating to conciliation and collective bargaining enacted in the last ten years. To what extent these measures will become operative when the Wartime Labour Relations Regulations become inoperative is a matter which will turn largely upon the outcome of the Dominion-Provincial Conference of Labour Ministers called in November, 1946, to consider the whole jurisdictional situation; thus there is little point in describing the various provincial enactments here.

It is enough to note that, apart from wartime measures, British Columbia, Alberta and Nova Scotia have statutes providing machinery similar to that of the I.D.I. Act and forbidding strikes or lockouts while the machinery is operating; that a Saskatcheawn act sets up somewhat different machinery; and that in New Brunswick a new act based on the Dominion Wartime Labour Relations Regulations may be brought into force by proclamation.

Collective Bargaining

Before the recent war several provinces enacted measures designed to establish the right of labour organizations to bargain collectively with their employers as to wages and working conditions; to facilitate the bargaining process; and to give some legal effect to the resulting contracts. Nova Scotia was the first province to establish by law the right of employees to organize; this was done by the Trade Union Act of 1937. These provincial measures have been suspended, however, during the currency of the Wartime Labour Relations Regulations, which deal in part with the same subjects, and the form they will take in the future depends upon the outcome of the Dominion-Provincial discussions on labour jurisdiction now under way. The pattern of coal mining labour relations was fairly clearly established before these provincial regulations were enacted, and does not appear to have been materially affected either by them or by the Dominion Wartime Labour Relations Regulations.

Of other types of legislation affecting coal-miners, such as those relating to the status of trade-unions, picketing, *et cetera,* it is not necessary here to speak except to note the fact that in all the coal-mining provinces there is legislation authorizing the check-off by the employer of union dues and other designated deductions. Nor is it necessary to stress the fact that mine workers participate in the benefits of social legislation, such as unemployment insurance and family allowances.

Their Working Conditions

Organization of Work

Most Canadian coal is mined underground, although in 1945 about 16 per cent of it came from stripping. There were in 1945 about 19,000 underground workers among the 25,000 men employed in and around the mines. Approximately 5,000 men were working in the various surface operations required to keep the underground mines operating, and the remaining 1,000 were engaged in stripping operations.

Only about 8,000 men were actually working at the face. These face workers, sometimes called the producers, are the front line troops of coal production. All the other men around the mine are engaged in preparing and maintaining the shafts and tunnels by which the coal is approached and hauled away, in supplying air and power for the men at the face and those behind them, in preparing and maintaining the transportation system for conveying the coal to the surface, and in cleaning, sizing and shipping the coal at the surface.

Whether mining is done by room-and-pillar or longwall method depends partly on local preference but principally on underground physical conditions. To the miners it makes a substantial difference which method is used. In the older system of room-and-pillar mining, in each two or three man team the members are highly dependent on each other, but the team as a whole is highly independent of other teams. The pace at which the team works and the way it does its work is largely a matter for its members to decide for themselves. Within the general wage rate structure they themselves determine how much they earn, for they are paid according to the tonnage they load out. Subject to supervision, they protect or risk their own lives, by the degree of skill and care with which they timber their workplace and do their work at the face, where the greatest number of mining accidents occur. These men develop a strong sense of independence and self-reliance.

Admirable as independence may be, for the present day mining operation it raises serious problems. In recent years the development of efficient coal cutting and loading machinery has made possible a substantial increase in the productivity of miners. A high degree of teamwork is essential to the success of mechanized mining, and particularly mechanized longwall mining. If one or two men on a thirty-man mechanized longwall team are absent, the whole team may be unable to complete its scheduled work; if a team on one shift does not complete its work, the succeeding shifts may be disrupted. Mechanization, which if successful makes possible higher wages for lighter work, requires substitution of a high degree of discipline for the old pioneer individualism, and the miners sometimes find the transition difficult. This problem of teamwork in longwall mining even where the operation is not fully mechanized is one of the causes of the present low productivity in Cape Breton, where the work of a shift is often disrupted by the absence of a few key men from large longwall teams. In Alberta on the other hand the absence of any one man usually affects much fewer fellow workers, because of the room-and-pillar system there prevalent. Further reference to the subject will be made in the detailed discussion of pro-

ductivity: the point to be made here is that modern technology is in conflict with the traditional habits of the miner, and that the conflict has an important bearing on the conduct of the industry.

Hazards of Coal Mining

The rate of accidental death among coal miners is higher than in any other occupation of similar size and nature, more than three times that for all Canadian males aged 20 to 64 years, according to a Special Report on Occupational Mortality covering the years 1931-32 published by the Dominion Bureau of Statistics. The mortality rate of coal miners in Canada from causes other than accident is also somewhat above that of the general male population, although lower than that of metal miners. Coal miners appear to be more subject to pneumonia and bronchitis than the general population, but tuberculosis of the lungs is relatively low.

An average of 68 men have been killed by accident in Canadian coal mines in each of the last twenty-four years. The personal risk that this has involved for the miners can be expressed in terms of the time men were exposed to the dangers of the industry, by showing the ratio of fatalities per million man hours worked. However, comparison of fatality records for particular provinces or even for the Dominion on an annual basis gives deceptive results, because one mine disaster can cause a violent fluctuation. A more useful comparison is given by the average numbers of fatalities per million man hours worked for the ten-year periods ending in 1931 and each subsequent year, which are as follows:

Ten Years Ending	Nova Scotia	New Brunswick	Saskatchewan	Alberta	British Columbia	Canada
1931	1.34	1.11	1.14	1.50	2.34	1.64
1932	1.36	1.54	1.52	1.40	2.23	1.61
1933	1.33	1.53	1.73	1.38	1.90	1.53
1934	1.29	1.50	1.73	1.34	1.92	1.49
1935	1.26	1.42	1.76	1.39	2.07	1.51
1936	1.23	1.39	1.38	1.21	2.20	1.44
1937	1.22	1.38	1.30	1.18	2.29	1.43
1938	1.27	1.33	1.30	1.20	2.48	1.49
1939	1.23	1.05	1.34	1.13	2.36	1.41
1940	1.16	1.00	1.24	1.19	1.45	1.26
1941	1.01	.82	1.28	1.39	1.42	1.25
1942	1.00	.61	1.06	1.38	1.51	1.23
1943	1.05	.57	1.06	1.48	1.58	1.29
1944	.99	.53	.99	1.42	1.46	1.22
1945	.95	.71	1.02	1.29	1.47	1.17

This clearly indicates that the coal mining fatality rate for Canada and most of the coal producing provinces has declined substantially over the last fifteen years. For all Canada, the fatality rate in the ten years ending in 1945 was only 71 per cent of the rate for the ten years ending in 1931. The Nova Scotia ratio, which has consistently been lower than that for all Canada, decreased by the same proportion. British Columbia shows the highest rate among the provinces, but it decreased by more than a third over the last fifteen years. The Alberta rate decreased until 1939, then increased almost to the 1931 level.

The Canadian fatality rate per million man hours has in most years been lower than the United States rate but higher than the United Kingdom rate. In U.S. bituminous mines the rate has ranged in the last twenty-four years between 2.23 in 1924 and 1.23 in 1945, with a fairly steady downward trend. In the six years 1938-1943, the U.K. rate ranged between 0.58 and 0.45.

Pay Basis

The men at the face, whether on longwall or room-and-pillar mining, are customarily paid in Canada on the basis of the weight or measure of the coal they win from the face and load onto conveyers or cars. This pay basis is known as the contract system: the miners contract with the operators to dig coal for so much per ton or per yard of coal mined. The other men, engaged in maintenance, development and haulage work, are customarily paid a fixed sum per shift or day: this is known as the datal basis. In United States mines, producers on mechanized mining teams are paid on the datal basis, as are the relatively few mechanized loading teams in operation in Western Canada.

The contract basis becomes extremely complicated, by reason of special allowances in addition to the basic rate per ton or yard. For taking out rock, for working in places made difficult or unusually uncomfortable by water or by a steep pitch in the coal seam, for timbering, for pushing mine cars a distance greater than normal, and for many other things, the miner may be paid a bonus, either per ton or per shift. These special allowances vary from field to field and mine to mine. For instance, the contract between District 18, U.M.W.A., and the Western Canada Bituminous Coal Operators' Association includes general clauses relating to minimum wages for "deficient places", miners doing company work, wet places, rock mining, and miners working in more than one classification: the contract goes on to schedule separately the wage rates and special provisions of each operator member of the Association, and in these individual schedules there are as many as fifteen possible special allowances provided for, aside from the prescribed rates for timbering, tracklaying, and similar jobs normally done from time to time by the miners. These allowances and special payments complicate tremendously the calculation and recording of the miners' earnings, and provide fertile ground for disputes.

The contract rates are customarily designed to enable a miner who does a good day's work to earn more for that day than all but a few highly trained specialists among the men paid on the datal basis. How much more the contract miner earns depends primarily on the amount of effort he puts into the job, but also of course upon the physical conditions of his work place and upon the adequacy of the mine cars and supplies made available to him. It is in an attempt to compensate for the inequalities in the physical conditions of the various work places, and for non-productive work which the miner is required to do, that the above mentioned special allowances have grown up.

Jobs paid at contract rates are normally sought after because of the better earnings. They are the jobs which demand the most skill. A "typical" history of a fully qualified miner working at the face might be that he started as a boy in a surface job (September 1946 rate in Cape Breton $4.74 per day, in western bituminous mines $5.07), worked around at various surface jobs for a few years (September 1946 rates in Cape Breton $5.84–$7.86 per day, in western bituminous mines $6.67–$8.11), then did underground datal work for a few years (September 1946 rates in Cape Breton $5.84–$6.96, in western bituminous mines $6.67–$9.77). While working underground he would have taken his miners' examinations, which are conducted by provincial authorities. As a first class miner, he could be given charge of a working face when a vacancy arose. Having received his miner's certificate, our "typical" miner is eligible for contract work at the face. The opportunity for such work may come soon or very slowly, depending on conditions in the industry. Average earnings of contract miners for a day's work, as reported by the Department of Labour, were, in 1944, slightly over $9 in Cape Breton; between $10 and $11 in Alberta.

The rates quoted above are wartime rates, representing all-time peaks for the areas to which they apply; but the description of the miner's career must be qualified as regards the war period, when a shortage of face workers led to special measures to speed up the progress of the worker to the face. In Nova Scotia, for instance, a man may now receive a certificate of competency as a miner after six months' intensive training as an apprentice.

Seasonal Variations in Employment

Daily earnings are not a good index of the income of coal miners. The industry has always been a highly seasonal one in Canada. In Cape Breton the summer is the busy season; on the Nova Scotia mainland and in the western provinces the autumn and winter are the busy time. For the rest of the year the miners have in peacetime often had work for only one, two or three days a week.

The seasonal variation in employment is worst in the western "domestic" coal mines. For instance, employment in the western "domestic" coal fields fell in June, 1939, to about one-fifth of the peak employment for that year. The western bituminous mines, which sell most of their coal directly to the railways, have worked more regularly than the mines producing coal for domestic heating, but even the bituminous mines have their slack periods. In eastern Canada there has not been nearly as great a decline as in the western "domestic" fields in the number of men on the payroll, but there have been great differences from month to month in the number of days work available per week.

On days when the mines are not hoisting coal there are at least a few men engaged in maintenance work. Frequently advantage is taken of the slack season to do development and repair work underground and in the surface facilities. There is a resulting seasonal shift in the composition of the working force, with underground workers becoming a lower proportion of total wage earners in the slack periods, in addition to the overall decline in employment. This trend, like the other seasonal shifts, is most marked in the Alberta "domestic" coal fields.

The causes of seasonal unemployment are in general related to the seasonal nature of consumer demand; in Cape Breton the cause is the closing of the St. Lawrence River in the winter. In the case of western "domestic" types of coal, remedial action has been complicated by technical difficulties of deterioration of the coal in storage.

Alternative Employment

The men seasonally unemployed must either seek employment in other industry, or live on whatever savings or unemployment insurance credits they have been able to accumulate. In Alberta, farm work has been the traditional alternative employment for seasonally unemployed coal miners, and the same is true to a greater extent in Saskatchewan. This alternative is, however, difficult for the man in the western bituminous and some of the sub-bituminous mines, for whom farm employment generally means migration to a different area whenever he is laid off at the mines. In the Maritimes, and particularly in Cape Breton, alternative employment is usually scarce.

Their Social Environment

Housing

Housing in coal mining communities has a bad reputation, but, except as to Nova Scotia, it is difficult to evaluate this reputation. The qualities that make a home as distinguished from a dwelling can not be measured by statistics, but even those physical characteristics which can be so

measured are not generally recorded separately so far as miners' dwellings are concerned. In the West, the miners live either in communities of less than 4,000 population, which do not receive separate statistical treatment in the Dominion Bureau of Statistics Census of Housing, or are part of larger communities of varied occupational composition, for which no statement concerning coal miners alone can be drawn from the census data. Glace Bay is the only coal mining town of over 25,000 persons; Sydney Mines, New Waterford, Springhill, Stellarton and Westville, all in Nova Scotia, are the only other towns in Canada of over 4,000 population which can be regarded as purely coal mining centres.

In these circumstances it is impossible to compare housing conditions as between the various coal mining areas of Canada, or, except for Nova Scotia, to compare housing as between miners' dwellings and other housing. From the 1941 Census Bulletin "Preliminary Housing No. D-5" it is possible to compare, as between the coal mining and non-coal mining towns of Nova Scotia, certain aspects of housing and related facilities.

The following table shows ranges of values and rents, and ranges of percentages of homes with certain characteristics and conveniences, for the two groups of Nova Scotia towns. The "mining town" group consists of Glace Bay, New Waterford, Sydney Mines, Stellarton, Westville and Springhill; the "non-mining town" group consists of Sydney, North Sydney, New Glasgow, Truro, Amherst, Dartmouth and Yarmouth, that is to say all Nova Scotia towns of more than 4,000 persons which are not almost exclusively coal mining towns. Halifax is also excluded because it is so much larger than the other towns.

—	Mining Towns	"Non-Mining" Towns
Average monthly rent, tenant-occupied dwellings ($)	8 – 13	15 – 29
Average value of owner-occupied dwellings ($)	1,142– 2,808	1,752 – 3,676
Percentage of dwellings owner-occupied	39 – 71	44 – 60
Percentage of dwellings needing external repairs	21 – 39	12 – 29
Percentage of dwellings with furnace heating	17 – 57	37 – 83
Percentage of dwellings with running water	87 – 99	90 – 96
Percentage of dwellings with flush toilet	47 – 70	83 – 95
Percentage of dwellings with electric lighting	95 –100	85 –100
Percentage of dwellings with gas or electric cooking	– 5	4 – 25
Percentage of dwellings with refrigeration, ice or mechanical	24 – 58	47 – 79

Company Houses

In both eastern and western mining areas it has long been a practice of the mining companies to build houses themselves and rent them to the miners. In some provinces the company held all land in its mining area under lease from the Province, and could not sell it: the only way in which housing could be made available was therefore on a leasehold basis. Uncertainty of employment and earnings have tended to deter miners from purchase of homes, even where purchase was legally possible. These reasons have applied with varying force in all mining areas, and in some areas it was, in addition, the past policy of the operators to keep control of the men through ownership of their living quarters.

Naturally the quality of company housing varied according to the resources of the operator and also according to his policies. In some of the western mining camps the bunkhouse was long the principal form of housing. In some other areas, Cape Breton for one, some houses which were roomy, solid, and modern in their time were built. Whatever the standards, the mere fact that the houses were owned by the employer has tended to cause a feeling of insecurity and resentment among the tenant-employees, a sense that their lives were dominated in every respect by "the company". Many operators, realizing the strength of

this sentiment, are taking steps to discontinue the practice of building company houses; some are gradually selling the company houses to their employees at reasonable prices.

However, the conditions which in the past discouraged ownership by employees of their homes continue to operate, and it is not reasonable to expect that in remote communities, or at mines which are not assured of long life, or in areas where employment is irregular, adequate housing will be provided in the future any more than in the past by the miners themselves.

The National Housing Act as recently amended includes provision for direct loans from the government's Central Mortage and Housing Corporation to operators of mines, to assist them to provide housing for employees. It is understood that this change was made because certain mines were unable to obtain sufficient labour because of housing shortages which neither the miners themselves nor any private lending agency would overcome. These loans may be for terms up to fifteen years; interest 4 per cent; security a first mortgage or, on leasehold land, a first charge upon the project and the interest of the borrower in the land on which it is built. Profits from rental of houses so financed are limited, and any earnings above this limit must be used to reduce rents. Dwellings built under such loans may be sold to occupants, and there is provision for the release of such home owners from the general mortgage on the project. At the time of writing some of the western mining operators were negotiating for such arrangements but none had made final commitments.

Closed Towns

Closed towns were an outgrowth in the West of control by the mine operator of all land within convenient distance of the pithead, and in some cases of a practice of employing only men who lived in company quarters. In such towns, not only living quarters but stores, hotels and service facilities were run either by the operator or under license from him. In addition to resentment at such monopolization of commercial activities, a common complaint was that town utilities such as lighting, sewage disposal and water supply were arranged at the will of the company rather than through usual municipal organization. Even where these complaints were not justified by any substantial difference between what the company provided and what a free municipality could have provided, there often remained that sense of insecurity and domination which in lesser degree has characterized the attitude of miners to company housing. The abuses which once characterized some closed towns have largely been done away with through provincial government action and collective bargaining.

Pensions

Among the coal miners in Canada the only ones eligible for a pension arising out of their employment are the employees of the Dominion Coal Company and the Old Sydney Collieries. The Dominion Coal Company plan was instituted in 1923: the payment of pensions is purely voluntary on the part of the company and the employees do not contribute to the pension fund. Pensions may be granted after twenty-five years of service to any male of 65 or any female of 55 years of age, with a maximum of $75 per month. In 1945 the pension fund was paying at the rate of $109,500 per year to 247 pensioners, an average of $36 per pensioner per month. However, there were in the employ of the company at

that time over 700 men over 65, most of whom were estimated to be qualified by length of service for pension and 115 of whom had actually applied for pension. The situation was that the funds of the company available for pension payments were so limited that they could not take care of all the employees eligible for pension, and consequently eligible men were faced with the choice of stopping work without a pension or continuing work until deaths amongst those receiving pensions made way for them on the pension list.

A similar pension plan was put into effect at January 1, 1946, by the Old Sydney Collieries. The employees do not contribute to the fund and have no legal right to the pension. By May, 1946, some 70 past employees were receiving the pension. There is not yet sufficient experience to show whether the funds available will be adequate to afford pensions to all eligible men.

Elsewhere in Canada the coal miner is dependent on his own savings or upon the federal Old Age Pension to provide for the years when he can no longer earn his living. Both District 18 and District 26 in their submissions to this Commission advocated an industry-wide pension plan to be financed by joint contributions from men, operators and government. A plan of this nature would assist in the recruitment of men in the industry by providing the sense of security which is lacking in the minds of the mine workers to-day. Moreover it might improve industrial relations in the industry, as the contributions of the operators would help to convince the miners of the operators' interest in their welfare. We are aware that there are difficulties in creating adequate pensions based on earnings when these fluctuate as widely as they do in the coal mining industry but these difficulties would not appear to be insuperable. We are of the opinion that an immediate study should be made of the practicability of a three-way pension plan covering all mine workers and that every effort be made to implement such a scheme.

General Welfare

Growing attention has been paid in various countries in recent years to methods of providing for the improvement of the social conditions of coal mining communities and for the support of miners in times of incapacity, unemployment and special hardship. Recent arrangements for welfare funds in the coal mining industry in the United States increased Canadian interest in the subject. In the summer of 1946 District 18 of the U.M.W.A. secured the establishment of a similar fund in most of that District, and at the time of writing District 26 has announced its intention to negotiate with the operators for the establishment of a similar fund.

The District 18 welfare fund is financed by payment by the operators of three cents per ton of coal mined, commencing October 1, 1946. The rules governing the administration of the fund are still being worked out by a committee representing the union and the operators, and pending completion of its work the accumulating contributions are being held in trust by representatives of the union and the operators. Although the purposes for which disbursements from the fund will be made have not yet been precisely defined, it is expected that they will be similar to the comparable funds in the United States. The United States welfare funds (one for the bituminous and one for the anthracite mines) are to be used for making payments to miners and their dependents and survivors with respect to wage loss not compensated or not adequately com-

pensated under the provisions of Federal or State law and resulting from sickness, permanent disability, death or retirement, and also with respect to other related welfare purposes as determined by the trustees. A comparable fund was created in the United Kingdom in 1920 for the improvement of social conditions for colliery workers and for miners' education.

MAIN PROBLEMS INVOLVING THE MINE WORKERS

This section deals with the principal problems in the field of industrial relations in coal mining: the maintenance and improvement of the mine workers' living standards, the maintenance and improvement of their productivity, and the achievement of mutual understanding and the highest possible degree of co-operation between labour and management. These are described as the main problems, because any of the multitude of problems that arise in industrial relations in this industry can be brought under one or another of these headings. These three problems, or groups of problems, are closely interwoven, so that action directed to any one of them is likely to affect the others in some degree.

Mine Workers' Living Standards

From the viewpoint of the men, the chief problem is to improve or at least maintain their standard of living. So far as living standards depend on money income, they depend not only on wage rates, but also on the number of days' work available per man per year.

Wage Rates

The vast majority of Canadian coal miners are paid either a daily wage rate or a rate based on the tonnage of measure of coal mined. Only supervisory staff and clerical workers are paid by monthly salary. The following table shows the daily wage rates for labourers and the average daily earnings for contract miners in selected years for the Canadian coal mining provinces and in Western Canada for some of the principal coal fields, as recorded by the Department of Labour. There are of course a large number of occupational classifications in the coal mining industry, but the classifications selected are basic and sufficient to indicate the range of wages. Apprentices and boys are paid lower rates than those paid to labourers, and a few highly skilled technicians are paid more than contract miners, but the vast bulk of mine workers fall in or between the classifications here shown.

Historically wage rates have been lower in Nova Scotia and New Brunswick than in Alberta and British Columbia, although the gap has narrowed substantially in recent years. These differentials reflect differences in productivity. Lower rates have also customarily been paid in Saskatchewan. Wage rates were higher immediately following World War I than at any time prior to the recent war years. Between the two wars, however, they never fell to the pre-1914 level.

From the point of view of the industry, the significance of the recent wage increases is their effect on the cost structure. Labour cost per ton as shown by some operators more than doubled between 1939 and 1944. The proportion of labour cost to total cost also increased somewhat; as shown in the chapter Financial Aspects of Production, labour cost was 58 per cent of total cost of

COAL MINING WAGE RATES

Year	Nova Scotia		New Brunswick		Saskatchewan		Alberta: Province*		Alberta: Lethbridge		Alberta: Drumheller		Alberta: Edmonton		Alberta: Crowsnest* and Mountain Park		British Columbia: Vancouver Island		British Columbia: Princeton		British Columbia: Province†	
	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.
Datal Rates for Labourers—																						
1921	3.90	3.80	...	...	...	...	6.89	6.58	...	...	...	...	...	...	...	...	4.71	4.54	...	...	...	...
1925	3.35	3.25	...	...	...	...	4.35	4.10	...	...	...	...	...	...	...	...	3.97	3.76	...	...	...	...
1929	3.35	3.25	3.35	3.00	...	...	4.54	4.28	...	...	...	...	...	...	4.47	4.39	3.97	3.76	...	...	...	...
1933	3.14	3.12	2.89	2.71	2.66	2.53	...	...	4.45	4.25	4.20	4.00	3.46	3.14	4.47	4.39	4.14	3.77	3.90	3.87	...	...
1939	3.36	3.36	2.83	2.61	3.24	3.08	...	...	4.85	4.62	4.85	4.62	3.78	3.70	5.01	4.90	4.60	4.00	3.90	3.87	...	...
1944	5.67		5.18		5.00		...		6.58		6.58		6.58		6.67		...	...	...		5.1	
Weighted Average Daily Earnings for Contract Miners—																						
1921	7.22		...		...		9.57		...		...		...		...		8.10		...		...	
1925	6.08		...		...		7.00		...		...		...		...		6.78		...		...	
1929	6.65		3.83		...		7.85		...		...		...		8.72		6.75		...		...	
1933	5.60		3.54		4.37		...		7.17		6.23		5.10		8.17		5.70		...		...	
1939	6.67		3.56		4.28		...		7.95		7.79		6.79		7.85		6.65		...		...	
1944	9.14		6.79		7.79		...		10.76		10.76		10.76		10.57‡		...		...		10.37	

U.—Underground.
S.—Surface.

* Including B.C. Crowsnest.
† Excluding B.C. Crowsnest.
‡ This figure appears to be too low.

NOTE: For contract miners daily earnings are shown rather than rate per ton because variations in physical conditions affecting productivity from field to field make it meaningless to compare tonnage rates from field to field.

SOURCE: Research and Statistics Branch, Department of Labour.

production at Dominion Coal Company over the years 1936–1939, 60 per cent over 1940–1944, and in 1944 was 64 per cent. At the other major Nova Scotia operations the comparison of the proportion of costs attributed to labour was:

—	1936–39 Average	1940–44 Average	Year 1944
Cumberland	59	61	64
Acadia	57	62	66
Old Sydney	59	62	61

In the other coal mining areas, labour costs formed roughly the same proportion of total costs over the period 1940–1944 as over 1936–1939, ranging between 50 per cent and 62 per cent; but for the year 1944 increases over the 1936–1939 level were shown in most cases. There was one notable exception: in Saskatchewan labour costs declined from 39 per cent to 24 per cent of total costs as between 1936–1939 and 1940–1944.

It should be borne in mind that labour cost per ton is not affected by wage levels alone, but also by productivity, according to the general formula

$$\frac{\text{average daily earnings}}{\text{tons per man day}} = \text{labour cost per ton.}$$

For example, recent wage increases in Nova Scotia, having been accompanied by decreases in productivity, have been followed by increases in labour costs per ton proportionately greater than the wage increases.

Coal mining wage rates advanced further between 1939 and 1945 than did the rates for most other industry classifications, as indicated by the following Department of Labour calculations showing 1945 wage rates as percentages of 1939 rates for major industrial groups:

	Per cent
Coal mining	145
Metal mining	128
Logging	161
Construction	131
Manufacturing	143
Transportation and Communication	129
Service	136
General Average	140

In discussing Canadian coal mining wages, reference is often made to the higher level of wages in the United States. This comparison is virtually valueless unless due weight is given to the comparative levels of general wage rates, annual earnings and cost of living patterns of the two countries, and to variations in the productivity of coal mining labour as between Canada and the United States.

Changes in cost of living levels modify the importance of changes in the level of wage rates, since real wages depend on prices. However, a more important relationship, discussed later, is that between average annual earnings and the cost of living. This is mentioned here only because the miners, and the operators, tend to place primary emphasis upon wage rates rather than annual earnings.

Regularity of Employment

Steadiness of employment is of central importance to the miners' living standards. It depends, however, upon regularity of demand for coal and upon technical problems of production scheduling, which are matters beyond the

scope of this chapter. They are also matters beyond the control of the miners, except to the degree to which their wage demands, their productivity and their contribution to the industrial relations of the industry affect the cost structure and the reliability of the industry in relation to competing coal and other fuels.

A full working year for a mine worker, on the basis of the 5-day week and 52-week year requested by the miners, would be 260 days, less statutory holidays; absences from work for good reasons would probably bring the average somewhat below 250 days. If a less hopeful view is taken, and some seasonal inactivity is considered inevitable because of the seasonal nature of demands for coal, 200 days of work per year might be taken as a rough standard of what the average miner could reasonably expect in peacetime. During the war years many mines have been working more than 260 days.

To learn the actual experience of the industry in terms of days worked per man the Commission through the co-operation of the industry collected a sample of the distribution of shifts worked per man in the years 1931, 1936 and 1939–1944. The summarized results of this sample are reproduced here.

DISTRIBUTION OF SHIFTS WORKED
SAMPLE MINES, SELECTED YEARS 1931–1944

(Canada by Regions, Weighted According to Regional Coal Mining Employment)

Region	Year	Percentage of Men Working			
		Less than 100 Shifts	100–199 Shifts	200–299 Shifts	300 Shifts and more
Nova Scotia	1931	18	62	17	3
	1936	8	41	45	6
	1939	5	42	47	6
	1942	16	25	44	15
	1944	9	20	49	22
Saskatchewan[1]	1940	64	11	10	15
	1942	61	13	10	16
	1944	46	12	29	13
Alberta Domestic Coal Fields[2]	1931	68	26	6	....
	1936	44	42	13	1
	1939	47	39	13	1
	1942	36	27	31	6
	1944	31	22	42	5
Western Steam Coal Fields[3]	1931	23	61	13	3
	1936	8	56	30	6
	1939	11	47	37	5
	1942	16	17	53	14
	1944	14	13	62	11
Vancouver Island	1931	29	30	35	6
	1936	13	14	65	8
	1939	15	20	62	3
	1942	28	21	47	4
	1944	15	23	58	4
Canada[4]	1931	31	51	15	3
	1936	16	42	37	5
	1939	16	40	40	4
	1942	22	23	43	12
	1944	15	19	50	16

[1] No data available for years prior to 1940.
[2] By "domestic" coal is meant high volatile "B" bituminous and lower rank coals.
[3] By "steam" coal is meant high volatile "A" bituminous and higher rank coals.
[4] In the Canada figures, the Nova Scotia weight is increased to allow for coal mining employment in New Brunswick.

In 1931 only 18 per cent of Canadian coal mine workers worked 200 shifts or more; in 1936 there were only 42 per cent who had this much work, and in 1939 only 44 per cent. This group included maintenance men, who work full time whether the mine is hoisting coal or not. During the war years the percentage working 200 or more shifts has increased rapidly, until in 1944, 50 per cent of the men worked between 200 and 300 shifts and a further 16 per cent worked 300 or more.

In 1931 almost a third of the men worked less than 100 shifts. The fact that during the war years the percentage of men working less than 100 shifts increased from the 1939 level is a reflection not so much of under-employment as of high turnover; the men in this group in the war years when employment was generally available were principally those who were on the payrolls of the reporting companies only for short periods. For this reason, while in the thirties the less than 100 shifts classification is a partial reflection of the importance of seasonal employment in the various fields, in the years following 1939 it is of little significance in most areas. Exception to this statement must be made in the cases of Saskatchewan and the Alberta "domestic" coal fields, where many men are employed for three months or less in the year. In these fields the high proportion of the men shown to be working less than 100 shifts in the war years reflects seasonal unemployment as well as turnover.

Among the various areas shown separately in the summary, Nova Scotia and the western "steam" coal fields showed the highest level of activity. In Nova Scotia in 1931 only 20 per cent of the men worked 200 or more shifts, but in all the subsequent years sampled more than 50 per cent worked 200 or more shifts, and the proportion reached 71 per cent in 1944. Conversely, Nova Scotia shows the lowest proportion in the less than 100 group, reflecting a relatively low rate of turnover, relatively low seasonal variation in activity, and the high level of activity of the recent years. In the western "steam" coal fields the long-term problem is similar: the proportions of 84 per cent, 64 per cent and 58 per cent of the men working less than 200 shifts in the years 1931, 1936 and 1939 suggest that the real problem here also is to make full use of the capacity of the men dependent upon the industry, and thereby to provide them with adequate annual earnings.

The relatively small (in terms of employment) Saskatchewan field illustrates by the high proportion of men working less than 100 shifts even during the war years the highly seasonal nature of operations in that field. The Saskatchewan operation is probably the best adjusted of all the seasonal operations in that respect, since many of the extra men the industry employs in the busy season are farmers for whom coal mining is a supplementary source of income; but a substantial proportion of the men are primarily dependent upon the coal mines and have in the past experienced seasonal unemployment. The increasing productivity and success in securing an industrial market in recent years appear to make employment prospects for this field more favourable than in the past.

In the Alberta "domestic" coal fields, the seasonal variation of employment, although not as extreme as in the Saskatchewan field, is of prime importance. This seasonal variation, plus a high rate of turnover, explains the very high proportion of men in the Alberta "domestic" coal fields shown to work less than 100 shifts in all the years covered in the sample. Conversely, in none of the years covered did more than half of the men reported by the Alberta "domestic" coal operators work more than 200 shifts. This seasonal factor in the Alberta "domestic" fields is a long-standing problem to which no adequate solution has yet been found. Some of the men turn to farming in the slack season, either on their own account or as employees, but many of the men have over the past years been unable to count on securing other employment to supplement their work in the coal mines. From the point of view of the men, this situation produces

highly unsatisfactory annual earnings. Until some method can be devised for maintaining activity in the slack period in these coal fields, each individual coal mine worker will have to make his own adjustment.

On Vancouver Island a comparatively high proportion of the men employed worked 200 or more shifts in all the years covered by the sample. As in Nova Scotia, there has been a great deal of partial employment in this field.

Annual Earnings

No adequate statistics of earnings in the coal industry are kept on a national basis. However, from payroll and employment figures collected by the Dominion Bureau of Statistics, it was possible to work out approximate average annual earnings. These figures appear to contain a margin of error, but this difficulty does not seriously affect the comparison of these annual average earnings figures from year to year and from district to district. It does mean that they can not be taken as an exact statement. It should also be remembered that averages do not adequately show the possibilities of the industry as a source of income to the individual: as demonstrated later, there is a wide range in earnings above and below the average. For these reasons the average earnings figures are not here tabulated, but are compared in general terms as between periods of time and among the various Canadian coal mining areas.

Since 1922, the first year for which such information is available, the average for Canada of annual earnings of coal mine workers from coal mining first exceeded $1,400 in 1941, while in the five years 1931 to 1935 the average ran below $1,000 in each year, being just over $800 in 1933. In 14 of the 24 years covered the average was $1,200 or over.

As between coal mining areas there are wide variations in the annual average. In New Brunswick the average exceeded $1,000 only in 1923, 1927 and 1942 to 1945 inclusive, and in nine of the 24 years it was below $800. Even in 1944 and 1945 the New Brunswick average was about $500 below the national average. Similarly in Saskatchewan average earnings exceeded $1,000 in 1923 and then not again until 1941, and still in the recent years have lagged behind the national average: they have been below $800 in 8 of the 24 years on record. In both these Provinces the primary reason for the discrepancy from the earnings for the principal coal producing areas is a lower wage scale which reflects in both Provinces a relatively low grade of coal, in New Brunswick low productivity, and in Saskatchewan a short mining season.

The Alberta "domestic" coal fields have shown the next lowest level of earnings, with the exception of a few years in which earnings in Nova Scotia were lower (1924, 1925, 1932, 1933) and the most recent years when earnings on Vancouver Island have been lower. Here again the reasons for the relatively low level of average earnings would appear to have been the lesser value of the coal produced, a correspondingly low wage scale, and seasonal inactivity.

Vancouver Island, where for many years average earnings were higher than in any other principal coal field in the country, has in recent years fallen behind the level of earnings in the western "steam" coal fields and in Nova Scotia. The daily wage schedule since 1938 has been similar to that in the Crowsnest and other "steam" coal fields, but problems of markets and difficult physical working conditions have reduced activity on the Island below the level of those fields.

The highest rate of earnings has been enjoyed in the western "steam" coal fields and in Nova Scotia, with the western fields holding an edge over Nova Scotia in 16 of the 22 years in which comparison is possible. Even in these fields the average annual earnings have dropped below $1,000 in several years, in the western "steam" coal fields in 1933 and 1936, and in Nova Scotia in 1924,

1932, 1933 and 1935. It will be remembered that the wage rate in Nova Scotia has historically been lower than that in the western "steam" coal fields: the reason that earnings in Nova Scotia have from time to time exceeded those in the western "steam" coal fields is that the mines in Nova Scotia have worked more steadily.

To get a clearer picture of the earnings received by coal mine workers than that afforded by these approximate averages, the Commission through the co-operation of the industry secured records of the distribution of earnings among a substantial sample of the mine workers in the country, similar to the sample of distribution of work previously mentioned. A summary of the earnings distribution indicated by this sample, with a weighted distribution for Canada, is shown below.

DISTRIBUTION OF EARNINGS
SAMPLE MINES, SELECTED YEARS, 1931–1944

(Canada by Regions, Weighted According to Regional Coal Mining Employment)

Region	Year	Percentage of Men Earning				
		Less than $1,000	$1,000–$1,499	$1,500–$1,999	$2,000–$2,999	$3,000 and Over
Nova Scotia	1931	81	17	2	[5]	....
	1936	60	36	4	[5]	....
	1939	49	40	10	1	....
	1942	37	33	23	7	[5]
	1944	16	22	30	30	2
Saskatchewan[1]	1940	79	11	5	5	....
	1942	74	8	12	5	1
	1944	55	13	22	9	[5]
Alberta Domestic Coal Fields[2]	1931	86	12	2	....	....
	1936	78	19	3	....	....
	1939	78	16	5	1	....
	1942	47	19	20	14	[5]
	1944	35	11	22	30	2
Western Steam Coal Fields[3]	1931	66	24	7	3	[5]
	1936	46	42	10	2	....
	1939	30	42	23	5	....
	1942	23	15	34	26	2
	1944	14	11	32	39	4
Vancouver Island	1931	65	27	7	1	....
	1936	39	45	15	1	....
	1939	39	49	11	1	....
	1942	44	26	24	6	....
	1944	19	18	39	24	[5]
Canada[4]	1931	78	18	3	1	[5]
	1936	60	34	5	1	....
	1939	52	36	11	1	....
	1942	37	26	24	12	1
	1944	20	17	30	31	2

[1] No data available before 1940.
[2] By "domestic coal" is meant high volatile "B" bituminous and lower rank coals.
[3] By "steam coal" is meant high volatile bituminous "A" and higher rank coals.
[4] In the Canada figures, the Nova Scotia weight is increased to allow for coal mining employment in New Brunswick.
[5] Less than 0.5 per cent.

In 1931, 78 per cent of the coal mine workers in Canada were earning less than $1,000; in the Alberta "domestic" coal fields the proportion was 86 per cent. At the same time men earning $1,500 and over numbered only 2 per cent of the Nova Scotia total and of the Alberta "domestic" coal fields total, and ranged up to 10 per cent in the western "steam" coal fields.

By 1944 the picture had changed radically: 55 per cent of the men in Saskatchewan and 35 per cent of the men in the Alberta "domestic" coal fields were still earning less than $1,000 per year, but the detailed records indicate that most of these were men who worked only seasonally in the coal mines, and in some cases moved about from one mine to another even during the busy season. In Nova Scotia and the western "steam" coal fields, where employment is more stable, the proportion of men earning less than $1,000 was 16 per cent and 14 per cent respectively, while in Vancouver Island it was 19 per cent and in Canada as a whole 20 per cent. In these fields the group earning less than $1,000 was apparently made up largely of men who left the coal mines during the year, or commenced employment at the mines well on in the year, or who for various reasons worked only part time. By 1944 a third of the mine workers in Canada were earning over $2,000; in the western "steam" coal fields the proportion was 43 per cent.

In the western "steam" coal fields 1941 was the first year in which 50 per cent of the men earned $1,500 or more, while in Nova Scotia, the Alberta "domestic" coal fields, and Vancouver Island, this point was not reached until 1944. It had not then been reached in Saskatchewan. Until 1942 not 1 per cent of the coal mine workers in Canada earned $3,000 and over; in 1944 the proportion was 4 per cent in the western "steam" coal fields, 2 per cent for Canada.

In evaluating earnings data it is important to remember that the recent years represent an all-time peak in the earnings of coal miners. Up until 1939 more than half of the mine workers in Canada were earning less than $1,000 per year from coal mining, and until 1944 over half of them were earning less than $1,500. The proportion of one-third earning over $2,000 in 1944 is an event which has not previously occurred. High wage rates were fundamental to it, but even if high wage rates are maintained, the coal mines in general must work nearly full time in order to maintain this level of annual earnings. The real problem, once again, is regularity of work.

On the other hand, the earnings pattern during the war years did not reflect the maximum available earnings. As discussed in the section on productivity, there was an increase in absenteeism and labour turnover during the war, for a number of reasons. Had the men worked every available day, as they did during the 1930's, a larger proportion of them would have appeared in the higher earnings brackets. This point is illustrated by comparison, for a large eastern operator and two representative western bituminous operators, of the earnings pattern in 1944, first of those employees who worked less than 260 shifts, and second of those employees who worked 260 shifts or more, i.e., five days or more per week over the year.

	Eastern Operator		Two Western Operators	
	Men Working less than 260 Shifts	Men Working 260 Shifts or More	Men Working less than 260 Shifts	Men Working 260 Shifts or More
	5,562	4,576	657	254
	Per Cent	Per Cent	Per Cent	Per Cent
Proportion Earning—				
Less than $1,500	63	1	41	x
$1,500–$1,999	22	40	27	26
$2,000–$2,999	15	54	28	65
$3,000+	x	5	4	9

x Less than 0.5 per cent.

A large proportion of the men who worked less than 260 shifts and earned less than $1,500 in both East and West, was apparently men who were in the employ of the operators concerned for only part of the year, but this does not detract

from the primary point, that of the men who worked steadily, 59 per cent at this eastern operation and 74 per cent at these western operations earned over $2,000.

For a comparison of average earnings in coal mining with average earnings in some other industries of a more or less comparable nature (heavy work, large-scale industries), there were available only approximate figures on average annual earnings. Such averages appear below for selected years for gold mining; copper and gold mining together; silver, lead and zinc mining where carried on together; and primary iron and steel. They indicate that average earnings in coal mining in Canada were lower than in these other industries in all the sample years before 1944. In 1933 average annual earnings in gold mining were almost twice those in coal mining, and in 1936 and 1939 they were about 50 per cent higher.

—	Coal Mining	Gold Mining	Copper and Gold Mining	Silver, Lead and Zinc Mining	Primary Iron and Steel
	$	$	$	$	$
1933	802	1,541	1,354	1,269	1,049
1936	1,029	1,547	1,386	1,482	1,144
1939	1,118	1,675	1,567	1,699	1,374
1942	1,573	2,016	1,904	2,141	1,797
1944	1,990	2,041	1,965	2,042	1,930

Note—Non-ferrous metal mining data above excludes smelting and refining.
SOURCE: Research and Statistics Branch, Department of Labour.

Annual earnings and wage rates must be considered in relation to the cost of living to gain some idea of the real level of wages and earnings. For this purpose indices of wages and earnings in coal mining in comparison with the index of the general cost of living are shown below for selected years. Through the 1920's, when the coal mining wage rate index was lagging substantially below the cost of living index, the index of average annual earnings in coal mining compared favourably with the cost of living. Conversely, during the depression when the wage rate index ran at a level closely comparable with the index of the cost of living, annual earnings fell off sharply. During the recent war and up to 1945, while the official cost of living index increased only 20 per cent above the 1935-1939 average and the wage rate increased 50 per cent above that level, the annual earnings index increased 93 per cent above that level. To the extent that the general cost of living index is applicable to single occupational groups, this indicates that, as compared with the 1935-1939 average, real wages in coal mining by 1945 were up 25 per cent and real earnings 62 per cent. This comparison illustrates once again that the miners' standard of living is quite as dependent upon the steadiness of employment as upon the level of wage rates.

—	Index of Wage Rates in Coal Mining	Index of Average Annual Earnings in Coal Mining	Index of Cost of Living (General)
1923	116.7	133.2	120.7
1929	99.6	132.0	121.7
1933	95.5	76.5	94.4
1939	102.9	106.6	101.5
1942	116.4	150.0	117.0
1945	149.6*	192.9*	119.5

1935–1939 Average = 100 for all three indices.
* Preliminary.

Productivity

Productivity, measured by the average number of tons of coal produced per day per man employed, or tons per man-day, is the common yardstick of the efficiency of coal mining operations, because production per man-day at any given wage level determines labour cost per ton; labour cost is in Canadian mines from 50 to 65 per cent of total cost per ton; and cost per ton in relation to price levels determines whether the operation prospers or collapses. For the same reasons, it is a principal determinant of the wage rates and regularity of employment of the mine workers.

Productivity is affected directly by the physical characteristics of the coal field, by the equipment employed, by the efficiency of management and of engineering methods: these factors are dealt with in the chapters on Mining Methods and the Financial Aspects of Production. Productivity is also directly affected by the efficiency and attitude of the miners; it is to this aspect of productivity only that this section is devoted. It deals with the ways in which the mine workers affect productivity, and with the importance of productivity to the mine workers. Productivity in net tons per man-day in Canadian coal fields for selected years is shown below:

	1939	*1945*
Nova Scotia	2.34	1.58
New Brunswick	1.42	1.72
Saskatchewan	5.85	12.07
Alberta "Steam" Coal Fields	3.75	3.91
Alberta "Domestic" Coal Fields	3.46	3.93
Vancouver Island	1.84	1.89

In the United States bituminous coal fields, where productivity is generally higher than in Canadian fields, principally because of more advantageous physical conditions and a higher degree of mechanization, overall productivity from underground and stripping operations was 5.25 tons per man-day in 1939 and 5.67 in 1944. More than half of the United States coal which competes in the central Canadian market comes from States averaging 5.08 to 6.77 tons per man-day in 1944. Productivity in the United States anthracite fields was 2.79 tons per man-day in both 1939 and 1944. In the United Kingdom productivity is lower than in Canada, 1.27 net tons per man-day in 1939 and 1.13 in the second quarter of 1944.

The principal factors affecting productivity in which the mine workers are closely involved are the composition and balance of the labour force, methods of training and recruitment, absenteeism, and the state of labour-management relations. Labour-management relations is the subject of a separate section of the chapter.

Composition and Balance of the Labour Force

Reference was made in the first section of this chapter to the increasing proportion of older men in the mining labour force: whereas in 1931 the proportion of mine workers over 45 was 29 per cent in Nova Scotia and 28 per cent in Alberta, in 1941 it was 37 per cent in Nova Scotia and 46 per cent in Alberta. There is reason to believe that the increase in the proportion of older men has continued since 1941, and indeed was accelerated during the war years. Heavy enlistments drained off in the earlier war years the most physically fit miners. Physically fit young men did not come into coal mining at a normal pace, partly because of enlistments and partly because of other employment opportunities. Men who would normally have retired stayed on during the war years. It seems reasonable to infer that with this increase in average age and withdrawal of a large proportion of men eligible for military service, the physical capacity of the mine labour force was lower than before the war.

During the war there developed a shortage of certificated miners and a consequent imbalance in the labour force. The shortage of mine workers for all classes of work was not of critical dimensions but the shortage of face workers did seriously impair the efficiency of the whole force. This shortage resulted in a reduction in the volume of coal produced at the working faces, even though production per face worker was reasonably well maintained in most mines. The result was that the force of datal workers necessary to operate the mines, which for technical reasons could not be contracted proportionately to the shrinkage in the face worker force, did not have made available to it the volume of coal which it could have handled. In consequence there was a decrease in overall productivity in areas where this imbalance was marked.

It was most striking in Nova Scotia, where productivity declined by a third between 1939 and 1945. In other major areas productivity had by 1945 been restored to the 1939 or a higher level. In Nova Scotia, the proportion of face workers to total workers was 31 per cent in 1939, fell to 23 per cent in 1943, and 22 per cent in 1944. The Dominion Coal Company's overall productivity fell from 2.7 tons per man-day in 1939 to 1.6 in 1945, or 41 per cent, while the productivity of face workers fell from 7.6 to 5.7 tons per man-day, or 25 per cent. In 1945 the Company's total labour force was 95 per cent of the 1939 number, while the face workers were only 75 per cent of the 1939 number. By October, 1946, the non-producer force was 10 per cent larger than in 1939, while the face worker force was still only 86 per cent of the 1939 force.

The reasons for this imbalance and its continuation after the war are not entirely clear. The principal Nova Scotia operators report that enlistments were particularly heavy among face workers. It is easier to replace surface workers and underground haulage and maintenance men than to replace face workers. In Nova Scotia qualification for a miner's Certificate of Competency now requires either six months intensive apprenticeship training or eighteen months practical experience underground: in a shortage such as arose during the war, this time factor puts a limit on the speed of replacement. A second reason suggested for the failure to keep face workers in balance with the rest of the labour force is that work at the face is sufficiently arduous to require physically fit men, i.e., the same group from which the Armed Forces were recruiting during the war. A further explanation given is that a full maintenance staff is required to operate a mine whether there is a full crew at every working face or not, and that while it was possible to recruit enough men for maintenance, the new men assigned to the mines were so inefficient that more than the normal complement were required to do the work.

Several expedients were used during the war in attempts to improve the balance, by government agencies as well as by the operators. Miners were frozen in their jobs by Order in Council; provision was made for compulsory transfer of miners working in other employment, and for return of miners in the Armed Forces to the mines on special leave; the qualifications for work at the face were simplified, and special training schemes for apprentices instituted. The best that can be said of these schemes is that they slowed up the decline of the face worker force.

The question is naturally asked: was it not possible to restore the balance by up-grading men already working in the mines but not at the face? National Selective Service in 1944 shed some light on this question by a survey covering over 6,000 datal workers in the employ of the five principal Nova Scotia operators. While 53 per cent of these men held certificates which would permit them to work at the face, most of them were disqualified for one reason or another. Of the total surveyed, 36 per cent were reported medically unfit for face work, 29 per cent were declared by their employers to be essential in their present datal jobs, 10 per cent were over age for face work, 3 per cent under age, and 4 per cent

had not enough experience to qualify. Ten per cent declared themselves unwilling to work at the face, for reasons which varied from working conditions to the rate of income tax which would apply to their higher earnings. There remained only 8 per cent, 516 men, who were able and declared themselves willing to work at the face.

These 516 men were apparently available at a time when the shortage of face workers among these operators was 612 men. However, only 169 of the 516 potential face workers were at collieries where there was a need for face workers: even in as small an area as the Nova Scotia coal fields it is difficult to shift mine workers about from one colliery to another as needed, for the same reasons which make people anywhere reluctant to change their place of residence or to commute long distances. Further, the willingness of the 169 men to move to the face was never put to the test, for National Selective Service had bound itself in obtaining the information from the men not to release their names. The Companies therefore could not approach them directly, and National Selective Service did not attempt any compulsory direction of these men to face work. From previous canvasses of their employees, the operators believed that they had found all the men who were actually willing, as well as able, to move to the face.

Explanation is still required for the special reluctance of Nova Scotia mine workers to move to the face, because in the other coal mining areas, while this difficulty in maintaining the balance of the labour force arose, it was found possible to maintain overall productivity: indeed in Alberta the number of face workers fell below the 1939 level only slightly, and in British Columbia, while there was a decline in their number in 1941 and 1942, the 1939 level was reached again in 1943 and exceeded in 1944.

The primary reason for the reluctance of the Nova Scotia mine workers to go to the face appears to have been the lack of sufficient money incentive. This in turn arose from several factors. The first was that the differential between the pay of datal workers and that of contract miners had been narrowed during the war period, the datal wages having increased more than contract rates. The second factor was the practice of paying "extra shifts" which had arisen many years before in the employment practices of the Nova Scotia operators but became important only during the war years. This extra shift system is an outgrowth of the task system, by which a man is assigned a certain amount of work which is considered a full day's work, but which may in fact be completed in less than eight hours. It has become increasingly common in Nova Scotia under the stress of wartime manpower shortages and absenteeism to offer men who completed such tasks in less than eight hours another task which is also paid for as a whole day's work. Thus, for a few hours more than the normal eight (occasionally for no more than the normal eight) a man may earn two days' pay. Figures from the above mentioned National Selective Service survey indicate that in 1944 the number of extra shifts being paid for amounted to 16 or 17 per cent of the total shifts. The possibility of extra earnings through this method naturally diminished the financial incentive for taking a job at the face. A third factor of importance in the reluctance of men to move to the face was income tax. This had a more important bearing on absenteeism, but some men considered the net increase in their earnings after taxation, which would result from their transfer to face work, not worth the extra effort, responsibility, and danger involved. This factor was operative in all coal mining areas, but may have been particularly marked in Nova Scotia because of the decreased differential between datal and contract pay.

Training and Recruitment

In the past, the labour force in Canadian coal mines has been built up and maintained by immigration and by young men of the locality going into mining as a life work. Immigration has virtually stopped in the last two decades,

and young men appear reluctant to enter coal mining so long as alternative employment is available. The results of this situation are reflected in the wartime imbalance of the labour force and in the increasing proportion of older men within the force. In Nova Scotia, the fact that the population of the mining areas is increasing while employment opportunities remain fairly stable may mean that adequate numbers of recruits will be available to the mines, but even there young men are reluctant to enter the mines; in the western mining areas the same reluctance is observed and alternative work is more feasible.

Training in the past has largely been given by experience, as the men passed through successive work classifications. Some evening classes and correspondence courses have been available for men seeking certification as officials, and a few scholarships have been made available to bright young miners for short technical courses to fit them for work as officials. During the war an apprenticeship scheme was commenced in Nova Scotia, with government assistance to meet the shortage of face workers.

From the point of view of productivity, it is important that in the composition of the labour force a normal proportion of young men be maintained. This can only be done if work in the mines is made sufficiently attractive to compete with alternative employment. The growing trend to mechanization requires the skill and the adaptability of young men; and an increase in mechanization will make coal mining more attractive to them. Both recruitment and training are problems best dealt with by the industry itself, by management and the miners' unions together. The Commission commends the recent commencement in western Canada of a joint management-union investigation into means of increasing productivity in that area.

Absenteeism

A third major factor affecting productivity is absenteeism. Although accurate and comparable statistics on absenteeism on a national basis are not available, it is generally agreed that absenteeism is a problem in coal mining, and became a very serious one during the war years. This is not peculiar to Canada, but is shared also by the coal mines of western Europe and the United Kingdom, the United States and Australia. It is not solely a wartime problem: an estimate commonly given for "normal" absences for all reasons in coal mining is 5 to 10 per cent, as against 3 to 5 per cent for all industry. During the war, this proportion increased substantially. At the Dominion Coal Company, which commenced detailed records in 1943, absenteeism for the whole labour force increased from 19 per cent in 1943 to 28 per cent in the first nine months of 1946.

There were a number of reasons for this wartime increase. Perhaps the most important was that the earning power of the miners increased beyond their money demands. Before the war, because of intermittent unemployment and relatively low wage rates, the miners became accustomed to a low standard of expenditure. During the war, increased earnings combined with scarcity of consumer goods appear to have produced, at least in some cases, a belief that enough money could be earned during three or four days to supply all the miners' needs for a week. The miners were buying leisure. This attitude was easier to adopt because the men knew that they ran little risk of discharge for absenteeism during the acute shortage of mine workers.

A related factor was the increasingly high rates of income tax during the war years. This is a point which is difficult to establish, but some specific examples made available to the Commission support the statement generally made by reliable observers that the individual miner gauges very closely the proportion of each dollar which is taken in tax, and stops work at the point where

he feels the additional income retained is not worth the additional work required to earn it. Considerations of patriotism in many cases and desire to earn additional money even at reduced net rates in other cases have of course modified this attitude.

In Nova Scotia absenteeism had more serious effects than elsewhere, because of the prevalence of longwall mining, in which the absence of a few key man may disrupt the work of a whole shift, all the haulage and other supporting staff as well as the face crews. In the room and pillar mining prevalent elsewhere in Canada, a number of rooms may be idle through absenteeism, but the balance of the men can produce, although the supporting crew may not be working at full capacity.

Intra–Union Affairs

Productivity in Nova Scotia suffered during the war years from dissension within the union. A deliberate slowdown, which commenced at the end of April, 1941, and was formally abandoned in September of that year, resulted from dissatisfaction of some of the membership of District 26, U.M.W.A., with the District Executive, and was in particular a protest against the Executive's signature of a new contract with the operators without the customary prior referendum vote of all union members. The slowdown, which was conducted against the express advice of the International Executive of the U.M.W.A., caused a drastic decline in productivity. At the Dominion Coal Company, the operation most affected, net tons per man-day in 1941 were as follows:

January	2.48
February	2.49
March	2.51
April	2.42
May	1.97
June	1.85
July	2.04
August	1.84
September	1.84
October	2.45
November	2.46
December	2.42
Calendar Year Average	2.24

For Nova Scotia as a whole, productivity fell from 2.16 in April, 1941, to 1.81 in September. After the slowdown was called off, productivity for a few months returned to levels slightly above 2 tons per man-day; then a steady decline to the 1945 level of 1.58 tons set in.

Employer–Employee Relations

Employer-employee relations are a matter of emotion as much as a matter of fact: they vary from time to time and from place to place, depending upon factors of human personality as much as upon logic and factual circumstances. In one sense the other two main problems, living standards and productivity, are aspects of the problem of achieving co-operation, for there are no more important determinants of the nature of relations between men and management than the trend of earnings of the men and the trend of productivity of the industry. Also important in determining the state of relations at any given time are the history of past relationships and what the men and management each believe to be the present attitude and degree of efficiency of the other in the mutual enterprise.

Relations in the past have been frequently marked by strikes and work stoppages. According to the Federal Department of Labour, there have been since 1921 761 strikes and other work stoppages in the Canadian coal mining industry, involving a total loss of over 4.75 million potential man-days of work. Four hundred and seventy-one of these strikes and stoppages, resulting in a time loss of 2.5 million man-days, have been in Eastern Canada, 90 per cent of them in Nova Scotia, and 247 have occurred in Alberta, or Alberta and British Columbia together, with a time loss of 2.1 million man-days. If a "serious" strike be arbitrarily defined as one involving a time loss of 100,000 days or more, there have been no serious strikes in Nova Scotia since 1925, the last of four consecutive years in which serious strikes occurred. There have been no District-wide strikes called by the union in Nova Scotia since 1925, but enough work stoppages to cause losses of 60,000 or more man-days occurred in 1934, 1939, 1940, 1941 and 1943. The most serious strike in New Brunswick was one involving 60,000 days time loss in 1937. In Saskatchewan the most costly strike recorded in terms of man-day loss was in 1939, when the time loss was 14,000 days. Serious strikes involving mine workers in both British Columbia and Alberta occurred in 1922, 1924, and 1945, and in 1943, 94,000 man-days were lost in a strike for higher wages. The 1945 incident was a widespread work stoppage unsanctioned by the District Executive, not a formal strike. In the Province of Alberta itself there were serious strikes in 1925 and 1932. In British Columbia the most important strike in terms of time lost was in 1935, when the total time lost was 22,000 man-days.

Causes of the strikes, as recorded by the Department of Labour, were wages, hours, working conditions and related questions in 499 of the total of 761 strikes. Strikes over questions of union recognition, security and related matters numbered 262, and time loss involved in them amounted to only 19 per cent of the total time loss in the industry. This reflects the fact that the general principles of union recognition and collective bargaining have been accepted in most coal mining fields in Canada for many years, and that coal mining labour organization has been relatively free of jurisdictional disputes. Strikes in this industry have been mainly of two kinds; District-wide strikes arising from breakdown of contract negotiations, and local stoppages in breach of existing agreements. Since the 1920's the former variety of strike has become less frequent and the latter more frequent. Strikes during the early 1920's were usually undertaken to prevent wage reductions and were in both eastern and western Canada of a District-wide nature. In recent years most work stoppages have been caused by local grievances arising out of existing agreements, rather than by failure to reach agreement with the employers on District-wide questions concerning the wage schedules and similar fundamental matters. This applies particularly to Nova Scotia.

Many of these small local stoppages have been the result of the impatience of the men with the normal procedures for settling grievances. In both District 26 and District 18 the contracts between the miners' union and the operators set forth elaborate machinery by which a grievance may be negotiated at succeeding levels of authority and finally submitted to arbitration. Often the men in the locals affected by the grievance in question walk off the job for a few days without waiting for the grievance machinery to operate. Local stoppages sometimes occur for reasons which to the bystander seem frivolous, or even irrelevant to collective bargaining within the industry.

As to strikes arising in the course of negotiation for a new contract, the Industrial Disputes Investigation Act, in some cases provincial legislation, and the Wartime Labour Relations Regulations, preserved the legal right to strike but postponed its exercise until an attempt had been made to reach an agreement with the aid of Conciliation Officers and Boards. These measures did not always prevent such strikes. There is much to suggest that, so far as they rely chiefly on mere delay and the influence of public opinion, such measures are inadequate deterrents, particularly where the financial reserves of both parties are considerable. Since such legislation does not apply to coal mining alone, and since it is presently the subject of Dominion-Provincial negotiations, the Commission does not think it appropriate to comment further.

Compulsory arbitration is sometimes suggested as a method for eliminating or dealing with strikes. Wartime experience in coal mining indicates the difficulty of enforcing arbitration of general disputes even in times of national emergency. A case in point is the acceptance by the Dominion Government of the recommendations of the O'Connor Commission permitting a wage increase in District 18 arising out of strike action in 1943 without fulfilling the legal requirements of the Regional and National War Labour Boards. The success of this strike action is only one illustration of the difficulty of attempting to apply compulsory arbitration.

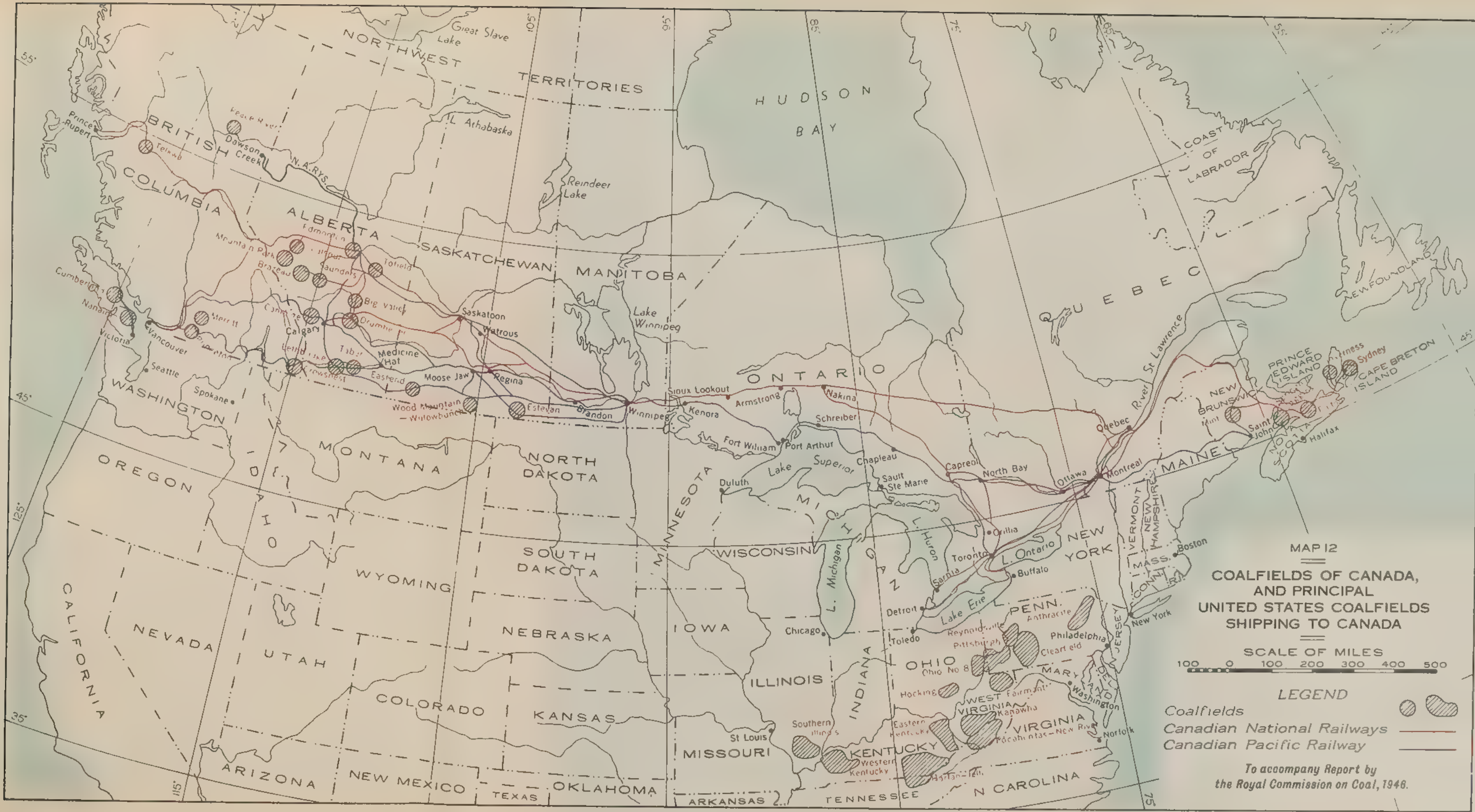
It has also been suggested that strikes can be done away with by legislation prohibiting them and providing sufficiently stiff penalties to make the prohibition effective. The House of Commons Standing Committee on Industrial Relations, in its recent report on industrial unrest in Canada, did not endorse this suggestion.

An approach to the problem of unauthorized local stoppages in breach of contract which is also frequently suggested is that the union in its own interests take whatever steps are necessary to strengthen its internal discipline sufficiently to minimize unauthorized stoppages. District 26 argues that this can not be done until the union can, by expelling an offender from the union, deprive him of his job. This is a principal reason advanced by District 26 for an agreement by which all employees of operators having contracts with the U.M.W.A. who were eligible for membership in the U.M.W.A. would be required to join that union. The operators oppose this request on the grounds that such a provision is an unjustifiable infringement of the liberty of the individual, and also point out that the union does not use all means now at its disposal for maintenance of discipline among its members. In District 18 such a provision is in effect but local stoppages in breach of contract still occur.

The attention of the Commission on several occasions was directed to joint production committees representative of men and management. Such joint committees, under various plans of organization and frequently under government sponsorship, have from time to time operated in many industries and in many countries. There was a considerable development of them, with varying degrees of success, in Canada during the war years; a number of coal mine operators in both eastern and western Canada participated in this form of industrial co-operation with their employees. The success of such committees is dependent upon the personalities of the men involved, and the good faith of men and management alike. It is too much to expect that joint production committees will function satisfactorily unless the atmosphere is such that collective bargaining functions smoothly. Where such an atmosphere does exist,

unions have on occasion co-operated actively with mine managements in improving production efficiency without setting up separate organizations for the purpose. Where it does not exist, joint production committees may gradually contribute to better mutual understanding, but will not in the short term end industrial friction.

Much that makes up the pattern of industrial relations is intangible. In the coal industry the attitude of management and labour to each other varies in one area from another. Responsible leadership is essential with both management and labour. District 18 and management have shown a willingness and capacity to negotiate with one another effectively. In that District, though the operators have expressed a desire for greater union responsibility in the maintenance of contracts, they nevertheless fully recognize the position of labour in relation to the industry. In the course of our sittings the largest Nova Scotia mining company displayed some lack of understanding in its attitude toward labour, submitting a brief on privileges enjoyed by its employees, and listing among them such things as collective bargaining, the check-off and the right of re-employment of employees who entered the Armed Services, all of which were guaranteed the mine workers by statute. On the other hand, work stoppages and other aspects herein reviewed indicate that this Company is entitled to a more responsible attitude on the part of the union. In Nova Scotia, the prosperity of the industry more than ever before is dependent upon a maximum of co-operation between management and labour, and progressive leadership by each is essential.


MAP 12
COALFIELDS OF CANADA, AND PRINCIPAL UNITED STATES COALFIELDS SHIPPING TO CANADA
SCALE OF MILES
100 0 100 200 300 400 500
LEGEND
Coalfields
Canadian National Railways
Canadian Pacific Railway
To accompany Report by the Royal Commission on Coal, 1946.
NORTHWEST TERRITORIES
Great Slave Lake
L. Athabaska
Reindeer Lake
HUDSON BAY
COAST OF LABRADOR
NEWFOUNDLAND
QUEBEC
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
NEW BRUNSWICK
PRINCE EDWARD ISLAND
NOVA SCOTIA
CAPE BRETON ISLAND
Prince Rupert
Telkwa
Peace River
Dawson Creek
N.A.RYS.
Edmonton
Mountain Park
Brazeau
Saunders
Tofield
Big Valley
Drumheller
Canmore
Calgary
Merritt
Princeton
Cumberland
Nanaimo
Victoria
Vancouver
Seattle
Spokane
Lethbridge
Crowsnest
Taber
Medicine Hat
Eastend
Moose Jaw
Regina
Saskatoon
Watrous
Estevan
Wood Mountain
— Willowbunch
Brandon
Winnipeg
Lake Winnipeg
Sioux Lookout
Kenora
Armstrong
Nakina
Schreiber
Fort William
Port Arthur
Lake Superior
Chapleau
Sault Ste Marie
Capreol
North Bay
Ottawa
Montreal
Quebec
St Lawrence River
Saint John
Halifax
Sydney
Minto
Orillia
Toronto
L. Ontario
Buffalo
Sarnia
Detroit
Lake Erie
L. Huron
L. Michigan
Duluth
Chicago
Toledo
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
COLORADO
ARIZONA
NEW MEXICO
TEXAS
OKLAHOMA
KANSAS
NEBRASKA
SOUTH DAKOTA
NORTH DAKOTA
MINNESOTA
IOWA
MISSOURI
ARKANSAS
WISCONSIN
MICHIGAN
ILLINOIS
INDIANA
OHIO
KENTUCKY
TENNESSEE
N CAROLINA
VIRGINIA
WEST VIRGINIA
MARYLAND
DEL.
PENN.
NEW JERSEY
NEW YORK
VERMONT
NEW HAMPSHIRE
MAINE
MASS.
CONN.
R.I.
Boston
New York
Philadelphia
Washington
Norfolk
St Louis
Anthracite
Reynoldsville
Pittsburgh
Clearfield
Ohio No 8
Hocking
Fairmont
Kanawha
Pocahontas – New River
Southern Illinois
Western Kentucky
Eastern Kentucky
Harlan-Hazard

CHAPTER VI

TRANSPORTATION

This chapter treats with the transportation of coal and coke, both by rail and water. In Canada transportation costs constitute a substantial proportion of the total cost of coal and coke to most consumers. Particulars relating to some important rates have been collected, and comparisons are made between coal rates in Canada and the United States, and between coal rates and rates applicable to other commodities in Canada. This study has been made to assist us to decide whether subventions could be abandoned and Canadian coal enabled to find a market solely by a reduction in transportation charges. While this report is being written the Canadian railways have applied for a general increase in freight rates*. The Commission has attempted to deal factually with present freight rates, but has restricted itself to a limited comparison within the present structure. No attempt has been made to analyse completely the Canadian railway rate structure.

THE FLOW OF COAL TRAFFIC IN CANADA

The channels by which coal used in Canada moves in normal times will be briefly described, using the movement in 1939, a year when the flow of coal was not materially affected by wartime disruptions of trade and transportation. Some of the changes brought about by the war which seem likely to persist into the postwar period for several years, at least, are also mentioned. In this connection attention is directed to an accompanying map.

As a general background for a description of the traffic flow, the production and volume of coal available for consumption are shown below for the years 1939 and 1944, by provinces. The figures of coal available given for certain provinces are not exact, mainly because locomotive fuel delivered to railways by mines in any province is shown as available in that province rather than at the point where the coal is actually used. The chief effect of this is to inflate the figures for coal available in Alberta while showing less than the actual coal available in Saskatchewan and Manitoba.

—	1939				1944			
	Production		Available for Consumption		Production		Available for Consumption	
	Million Net Tons	Per cent of Total	Million Net Tons	Per cent of Total	Million Net Tons	Per cent of Total	Million Net Tons	Per cent of Total
Prince Edward Island	0.0	0.0	0.1	0.4	0.0	0·0	0.2	0.4
Nova Scotia	7.0	23.8	2.9	9.8	5.8	12.5	3.7	8.3
New Brunswick	0.5	1.6	1.0	3.4	0.3	0.7	1.5	3.4
Quebec	0.0	0.0	5.1	17.6	0.0	0.0	8.0	17.9
Ontario	0.0	0.0	11.5	38.9	0.0	0.0	21.0	46.8
Manitoba	0.0	0.0	1.7	6.0	0.0	0.0	1.4	3.1
Saskatchewan	1.0	3.3	1.5	5.3	1.4	2.9	1.9	4.1
Alberta	5.5	18.7	3.7	12.8	7.4	16.2	5.0	11.2
British Columbia	1.7	5.7	1.7	5.8	2.1	4.7	2.2	4.8
Total	15.7	53.1	29.2	100.0	17.0	37.0	44.9	100.0
Imported from Great Britain	1.1	3.7	....	....	0.2	0.5	....	....
Imported from U.S.A.	12.5	42.1	....	....	28.7	62.5	....	....
Imported from other countries	0.3	1.1	....	....	0.0	0.0	....	....
Total imports	13.9	46.9			28.9	63.0		
GRAND TOTAL (including exports)	29.6	100.0			45.9	100.0		
Exports	0.4	....	....	....	1.0	....	....	....

*In the case of coal and coke the increases proposed are 20 cents per ton for rates $1.00 per ton and less, 30 cents for rates from $1.01 to $1.50, and 40 cents for rates over $1.50 per ton.

While these statistics do not illustrate the entire movement of coal since interprovincial movements of coal are not clearly shown, they indicate the dependency of Canada on transportation for the provision of coal-generated heat and power. The most significant wartime shifts are, of course, the very large increases in consumption, especially in Ontario and Quebec, increased production in the western provinces, reduced output in the Maritimes, the great reduction in overseas imports and the large increase in imports from the United States.

There follows a description of the transportation methods and routes, dealing individually with the movements from the various producing provinces, and from the different sources of imported coal.

From Nova Scotia

Nova Scotia's output in 1939 was 7,051,000 tons, of which 6,364,000 tons was available for shipment. The channels by which this coal reached its markets are the most varied of any producing fields in Canada.

All the fields are reached by railways. Some mines are served by lines owned by the coal producers, notably the Sydney & Louisburg Railway, a subsidiary of Dominion Coal Company, which connects with the Canadian National Railways at Sydney. Coal is shipped by rail in normal times to destinations throughout Nova Scotia and New Brunswick, to Prince Edward Island over the car-ferry and, to a limited extent, to points in Quebec and Eastern Ontario, the latter movements being assisted by subventions. The westward movement of Nova Scotia coal by rail is limited slightly by competition of New Brunswick coal, partly by competition from United States sources, and partly by the lower cost of moving Nova Scotia coals by water-and-rail to many destinations in Quebec.

Water transportation enables Nova Scotia producers to market their coal beyond the Maritimes, and also to some extent in the Maritime Provinces themselves. All of the coal production of the province is within a short distance of tidewater, with railway connections from the mines to leading piers at the ports, the most important being at Sydney and North Sydney on Cape Breton Island and Pictou on the mainland. More than half the province's coal shipments normally move by water. A substantial tonnage is shipped to Halifax, Liverpool and other Nova Scotia ports and to New Brunswick ports, especially Saint John. In some years Nova Scotia producers have exported as much as 350,000 tons to Newfoundland.

The St. Lawrence River is the artery which permits Nova Scotia coal to reach the large consuming areas of Quebec and Ontario. Up this river in 1939 moved nearly three million tons of Nova Scotia coal, about 45 per cent of the total Nova Scotia output. Montreal, Quebec and Three Rivers are the principal destinations for the large colliers used in the trade, but other ports also receive some tonnage. A considerable part of the tonnage received at the river ports is consumed in the port areas or distributed for relatively short distances by truck. Some coal is transferred to barges for delivery in the harbour area of Montreal.

The Lachine Rapids just west of Montreal, and the Lachine Canal accommodating only vessels of draft not exceeding 14 feet, form a boundary beyond which the large colliers cannot move. Some tonnage is moved from Nova Scotia in small vessels which can use the canal. Transfer of lading from the large vessels to canalers, either direct or more generally by loading to the docks and thence reloading from the docks to the canal-size ships, is required. More than a half million tons was so handled in 1939, assisted by subvention payments. The bulk of the tonnage moved to ports on Lake Ontario and on the Upper

St. Lawrence River, but there were movements to destinations such as Port Colborne on Lake Erie, Windsor on the Detroit River, and Midland and Little Current on Georgian Bay. Less than half of the coal so moved was consumed at the lake ports themselves. About 300,000 tons was shipped inland by rail to such destinations as Kitchener, Peterborough and Clarabelle.

In addition to the water movement west from Montreal, there is a substantial movement by rail inland from St. Lawrence River ports, not only from Montreal but also from Quebec and Three Rivers, tonnage from the latter port being shipped principally to destinations on the Murray Bay line and to Donnacona and Shawinigan Falls. Rail movement from Montreal in 1939 amounted to over 400,000 tons, the destinations including Thetford Mines, Noranda and Sherbrooke in Quebec and points in Ontario such as Ottawa, Cochrane and Clarabelle.

These combinations of water and railway transportation enabled Nova Scotia coals, with subvention assistance, to move to Ontario destinations more than 1,100 airline miles west of Sydney, the distances by the actual routes of movement being very considerably greater.

From New Brunswick

From a transportation standpoint, the distribution of New Brunswick coal is relatively simple. The total production in 1939 was 468,000 tons, of which 462,000 tons was available for shipment from the mines. Approximately 179,000 tons was sold to the railways and consumed principally in the province itself. The New Brunswick industrial market received about 45 per cent of the shipments, the principal destinations being Dalhousie, Bathurst, Edmunston and the power plant at Grand Lake. About 25,000 tons was shipped by rail to points in the adjoining State of Maine, slightly under 50,000 tons by rail to destinations in Quebec, principally in the Eastern Townships, and very small quantities to Prince Edward Island, Nova Scotia and Ontario. The Minto field has no convenient access to water transportation and the movement by truck is limited.

From Saskatchewan

Saskatchewan's coal shipments move to market wholly by railway, except for some tonnage moved by truck to points in proximity to the mines. Of 960,000 tons produced in 1939, approximately 904,000 tons was marketed, of which one-half was shipped to Manitoba points, 48 per cent to Saskatchewan destinations and the balance of about 16,000 tons to Ontario. The distribution is limited to points east of Moose Jaw. Winnipeg is an important market, the coal being used largely for industrial purposes. The Province's coal is not used for locomotive fuel, but substantial quantities are used by the railways in stationary heating plants. During the war, shipments of Saskatchewan coal increased to about 1,600,000 tons in 1943 and 1,300,000 tons in 1944, but there was no significant change in the distribution pattern.

From Alberta

The Province of Alberta presents many variations in the flow of coal traffic. The coals are technically classified as bituminous and sub-bituminous, and are popularly known as "steam" and "domestic". Some sub-bituminous coal, especially in the smaller sizes, is marketed for steam purposes, but generally speaking, the "steam" coal is bituminous, while the most of the "domestic" coal is sub-bituminous. Dealing first with bituminous coal, the production of which

amounted to about 3.4 million tons in 1939, the market is largely the railways, nearly 70 per cent of the production being sold for locomotive use throughout the Prairies and in Ontario. The balance is marketed for industrial and domestic purposes in British Columbia, the Prairie Provinces and the westernmost part of Ontario, with a small tonnage exported to the northwestern United States. Shipments of sub-bituminous coal in 1939 were about 2 million tons. Most of this coal was marketed in the Prairie Provinces for domestic use, while the movement to Ontario, aided by subventions, amounted to about 90,000 tons. The latter movement was somewhat larger during 1941 and 1942, due in part to conditions of short supply in the central provinces. In addition to the large domestic market on the Prairies, "domestic" coals move in sizeable volume to British Columbia points as far west as Vancouver, principally from the Drumheller, Lethbridge and Coalspur districts. The transportation of Alberta coals is largely by the railways, with trucks a factor in some localities.

From British Columbia

Coal is produced in British Columbia from three widely separated groups of mines. From a tonnage standpoint the Crowsnest Pass district is now the most important. Its production almost doubled between 1939 and 1944, while that of the Inland and Island districts declined. The latter coals are limited to markets in and west of the Rocky Mountains, where they encounter strong competition from competitive fuels, whereas the Crowsnest coal moves not only to British Columbia points as far west as Vancouver, but also to destinations as far east as northern Ontario. A substantial share of the Crowsnest coal is used by the railways as locomotive fuel. Crowsnest coal has had a market in the Spokane area and northern Idaho for many years, this outlet absorbing about 170,000 tons of coal in 1944. The entire distribution of Crowsnest and Inland District coals is by rail. The Vancouver Island coals have access to both rail transport for distribution on the island, and also to water transportation for delivery on the mainland of British Columbia and in the Puget Sound area in the United States.

From Great Britain

Of the 1,100,000 tons of British coal made available for consumption in Canada in 1939, about 94 per cent was anthracite. Almost three-quarters of the anthracite was received at Montreal, with substantial quantities also being unloaded at Halifax, Saint John, Quebec and Toronto. Comparatively little British coal was handled inland by rail, the bulk of the imports being consumed in the port areas, or shipped inland by truck. In addition to the tonnage received direct at Toronto, about 340,000 tons was transhipped from Montreal to Ontario points. Bituminous coal, totalling only about 67,000 tons, was received at Halifax, Saint John and Montreal.

From the United States

In the 35 years, 1910–1944, the smallest tonnage imported from the United States in any one year was just under 9,000,000 tons. Prior to World War II, the largest years for imports across the border were 1918 with about 21.7 million tons and 1923 with 20.4 million. In 1939, imports from the United States amounted to about 12.5 million, and in 1944 to about 28.7 million tons.

Anthracite imports grew from 2.6 million tons in 1939 to 4.2 million tons in 1944. The distribution of Pennsylvania anthracite by receiving areas in 1939 and 1944 was as follows:

—	1939		1944	
	Thousand Net Tons	Per cent of Total	Thousand Net Tons	Per cent of Total
Maritime Provinces	51.4	2.0	86.2	2.1
Quebec	596.6	22.9	1,573.4	37.5
Ontario	1,953.1	75.0	2,518.3	60.0
Manitoba	4.7	0.1	16.8	0.4
Prairie Provinces and British Columbia	....	....	....	....
Total	2,605.8	100.0	4,194.7	100.0

As shown, the consumption of United States anthracite is largely concentrated in Ontario and Quebec. The bulk of this tonnage reaches Canada by all-rail routes, principally through Buffalo, the car ferries across Lake Ontario to Cobourg, Ont., and across the St. Lawrence River to Prescott, Ont., and through the Adirondack Gateways, such as Rouses Point, Huntingdon and Massena, N.Y. This is a rather steady year-round movement, since the coal stocks well. In addition, in 1939 there was a movement by rail-and-lake through the ports of Sodus Point and Oswego, N.Y., on Lake Ontario, amounting to 290,000 tons, and through ports on Lake Erie amounting to 31,000 tons. About 85 per cent of the anthracite imported from the United States is in the larger sizes for use in hand-fired furnaces, and as size degradation is an important factor, all-rail movement is the preferred transportation method.

Bituminous coal imported from the United States was as follows:

—	1939		1944	
	Thousand Net Tons	Per cent of Total	Thousand Net Tons	Per cent of Total
Nova Scotia and Prince Edward Island	2.9	....	89.6	0.4
New Brunswick	13.9	0.1	40.5	0.2
Quebec	1,105.6	11.2	5,878.5	24.0
Central Ontario	8,035.2	81.7	15,654.6	63.8
Manitoba and Head of Lakes	674.8	6.9	2,847.6	11.6
Prairie Provinces and British Columbia	3.7	0.1	2.7	....
Total	9,836.1	100.0	24,513.5	100.0

The transportation of this tonnage employs a variety of agencies and facilities which together form a co-ordinated transportation and distribution system. All this tonnage is moved initially from the mines by railroad, either to the Great Lakes ports, to the junctions between Canadian and United States rail carriers, or in the case of a relatively small tonnage, to trans-shipping ports on the Atlantic seaboard. The lakes are closed for navigation during the winter months, so the lake movement must be concentrated into a part of the year, and facilities provided for storage on the docks or at the final destination. Railroads serving a number of the ports on Lake Ontario and Lake Erie operate dumpers for transferring coal from cars to vessels and track storage facilities for assembling cargoes at the ports. The same railroad facilities are, of course, used for coal moving to both Canadian and United States ports; of the coal moved by lake, about 20 per cent in 1939 and 28 per cent in 1944 was for Canada. There is a

rail-to-vessel coal transfer facility at Chicago, which is not railroad-owned, and which since 1941 has handled a substantial tonnage of lake coal originating in Illinois, Indiana and western Kentucky and moving to upper lake ports in Canada.

Lake coal moving to Canada originates principally in Pennsylvania, Ohio, West Virginia and Kentucky. The distance by railroad from the several districts to the lake ports varies from about 100 miles to over 400 miles. The major part of the lake coal for Canada is shipped from the adjacent fields of Pennsylvania, Ohio and northern West Virginia. Vessels used for the water-movement include large bulk-cargo steamers which handle most of the tonnage moving to destinations north of Sarnia, as well as to some of the lower-lake ports, self-unloaders equipped with conveyers and booms for unloading coal onto the docks, and canalers for movement through the St. Lawrence River canals. The bulk-cargo steamships handle coal up the lakes and ore and grain in the reverse direction. There is also some reverse movement in the canal-size steamers, including coal moving from Nova Scotia or overseas origins to ports on the Great Lakes.

The principal receiving ports for lake cargo coal in 1939 were Toronto and Hamilton with over one million tons each, Sault Ste. Marie, Fort William, Montreal, Kingston, Prescott and ports on Georgian Bay and Lake Erie. During the war years there have been substantial increases in the tonnage moved to Lake Ontario and St. Lawrence River ports, partly to replace Nova Scotia coals and partly as a result of increased consumption. There have also been increases in the movement to Upper Lake ports as a result of increased consumption and the withdrawal of western Canadian coals from that territory after 1942.

The port cities themselves consume most of the coal received by lake, but there are also important movements of coal inland. Coal is trucked in quite substantial volume from some docks to destinations close to the ports, and in some cases the truck movement may be for distances as great as 60 miles or more. The railways handle an appreciable volume of coal from the ports for varying distances.

The movement of imported bituminous coal via all-rail routes is smaller than that via the lakes, but it is still of importance. This coal originates in the same general areas as the lake coal, and moves through the gateways at Windsor, the Niagara Frontier, and the Adirondack junctions, as well as over the car ferries to Cobourg, Port Burwell and Prescott, forming one of the major commodities interchanged from United States railroads to Canadian railways at these junctions. The all-rail movement is less seasonal in its flow, and to a considerable extent the coal so moved is in prepared sizes which are subject to degradation when handled by boat. Coal shipped by all-rail routes at one time formed the larger percentage of Canadian imports from the United States, and the volume increased considerably during the recent war, but the lake routes will continue in the future to be the principal channel for bituminous coal received from the United States.

MECHANICS OF TRANSPORTATION BY RAIL

Canadian railways span the continent with two, and in some sections, three main lines. Unlike the truck, or the aeroplane or the steamship, the railway is not basically arranged as a point-to-point agency of transportation, even though it will receive a car of coal at a given mine and transport it to a given consumer many miles away. The distinguishing feature of railway operation as contrasted with other forms of transportation is that the car of coal is joined with many other cars of various commodities at receiving or marshalling yards so as to constitute a tonnage train[1] for the distance through which the car moves.

[1] This is a train which includes the maximum number of gross tons (lading plus equipment) which a given locomotive can pull over the ruling grade of the route to the next terminal. A ruling grade is a sustained uniform slope whose gradient or degree of steepness determines the tonnage or number of cars a locomotive can handle over a given portion of a railway.

The combining of all such single cars or groups of cars originating at many points into a full train for movement over the main lines requires the use of engines and crews to collect the cars from loading points and move them into yards. At the yards the cars are sorted into blocks or groups according to general destination areas. These blocks of cars are then built up into trains scheduled for movement into various districts or terminal areas. For example, a train may be assembled at Winnipeg with cars destined for Toronto, London and Windsor, and perhaps points intermediate between Winnipeg and the Toronto-Windsor area. Another group of cars may be assembled on an adjoining track at Winnipeg to make up another train for destinations between Ottawa and Quebec. The essential feature in the development of these two trains is that they shall have sufficient gross tonnage to utilize fully the power and speed of the locomotive which are to haul them. The tonnage that a locomotive can handle over a given route depends upon the capacity of the locomotive, the grade of the track, the sharpness of curves, the number of cars in the train, weather conditions, and finally, the operating practices used to assist the train over steep grades.

The mechanics of transporting freight by railway divide roughly into "yard operation" and "road operation". The criterion of efficient yard operation is the rapid assembly and weighing of cars and dispatching of trains. Any delay in these operations, such as waiting for the receipt of sufficient loaded cars to make up a tonnage train for a given general destination, has the effect of delaying all cars thus far received for that train, with a consequent reduction of car utilization, that is, ton-miles per car per day. The measure of efficiency in road operation is the ton-miles accumulated per locomotive-day. If a locomotive does not have a full train, it is not being fully utilized. Any inefficiency in yard and road operations has the effect of requiring more trains to move the same volume of freight. In congested parts of the railway, this is a vital factor as the main tracks have a capacity for handling just so many trains per unit of time.

Frequently it is necessary, for lack of sufficient tonnage in a given direction, to dispatch a train with less than its full capacity. The inefficiency inherent in such procedure is minimized in actual practice by adding a block of cars to that train at the first opportunity. This may be, and frequently is, accomplished without "yarding" the train at the intermediate terminal or pick-up point. The train involved pulls in on a designated track, the pre-assembled block of additional cars is attached, and the train proceeds with a minimum loss of time.

In mountainous country, maximum utilization of locomotives is effected where feasible by temporarily adding power (locomotive) to the head or rear of the train, when a succession of long steep grades is encountered. The alternative is to reduce the tonnage in the train by setting off a number of cars. Thus, by dispatching cars in full tonnage trains from a terminal, adding or subtracting blocks of cars, adding or subtracting power, and sometimes by doubling on hills, a maximum weight of lading and cars is moved at the highest practicable speeds, and with the minimum use of equipment. This is the essence of efficient railway operation. Any temporary condition, or special transportation necessity, which involves deviating from these practices is attended with additional costs.

Train-Load Operation

The above description of basic railway operating practices has been given in some detail in order that the reader may understand the factors that would be involved in the handling of "train-lot" movements of a given commodity. Suggestions have been made to this Commission that the railways might be able to transport coal from the Alberta mines to points in Ontario in solid trains at substantially lower costs to the railways, who could then offer to the shipper train-lot rates lower than the prevailing car load rates.

Trainload movements are to be found everywhere on this continent. In Canada a familiar example is the movement of grain. In the United States perhaps the most outstanding examples of train load movements are those of coal and iron ore, which will be shortly discussed. Train load rates as such are limited to a few exceptional cases in the United States, the most notable being the movement of molasses from New Orleans to Peoria, and the movement of coal from Arkansas and Oklahoma to St. Louis, but even these exceptional examples are, strictly speaking, not rates for trains carrying the designated commodity exclusively.

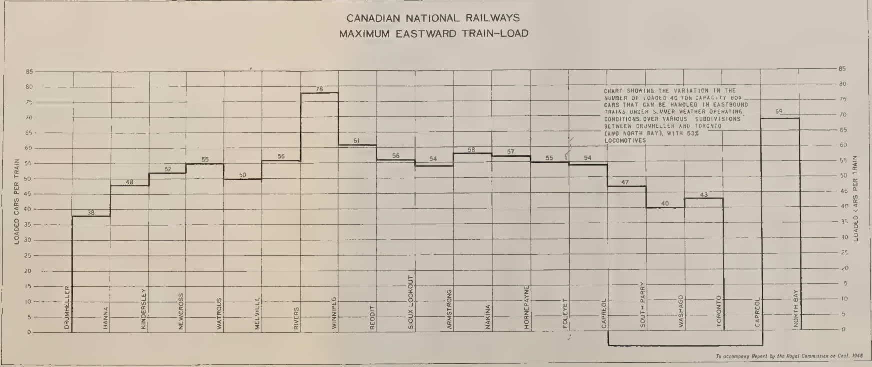
Many examples might be cited in which coal and iron ore are moved in solid trainloads in the United States. Practically all of the ore movements are from one point of origin (an ore-mine or lake dock) to a single destination (a lake port or a steel mill), and many of the solid coal trains originate at one or a very few mines and terminate at a single lake dock or perhaps at a coke plant. The volume of tonnage in some cases is so large that one day's shipments may make up not one but several trainloads per day. None of these examples constitutes trainloads moving on train-lot rates as such. The movement is handled in solid trainloads, because a full tonnage train is the efficient method of transporting freight by rail. To the extent that the volume of traffic provides such transportation advantages, the cost per ton-mile of performing this service is lower than for handling small or scattered shipments. Many coal rates in the United States are at a low level because the total movements for which they apply are so large as to provide one or more trainloads a day. These rates are not published as trainload rates as such, and the small shipper moving only one or two cars gets the benefit.

There are a number of factors that must be given consideration when determining the feasibility of solid-train movements at a solid-train rate from Alberta mines to destinations in Ontario. In the first place it would be necessary at any mining point to build up a train-lot which would involve holding cars in an assembly yard, generally for several days. At the same time coal destined to points in Saskatchewan and Manitoba would have to be shipped in the ordinary way. It would be necessary to separate cars for these points from the cars grouped in the train-lot movement; this in itself would delay dispatch of cars and increase switching costs. Furthermore, segregation of a solid train would probably result in more other trains operating without a full load, or would result in delay while cars for full trains were accumulated. There is a further vital factor; through the relatively level parts of the prairie long heavy trains can be handled, but in other divisions the conditions are such that the trains must be shorter. The accompanying charts show the maximum number of loaded cars that can be handled as a train over the various sub-divisions of the Canadian National and Canadian Pacific Railways between Drumheller and North Bay. By reference to these charts it will be observed that the capacity varies considerably in the different sub-divisions and, taking the Canadian Pacific as an example, it would appear that a train of 47 cars could be handled for the first sub-division out of Drumheller, but by the time the train reached the Fort William-Schreiber sub-division it would have to be reduced to 26 cars, while intervening subdivisions can take trains of 70 cars or more. It is not necessary to review the situation for the Canadian National Railways. In short, under efficient railway operation, no solid train leaving Drumheller would maintain its identity en route to North Bay in Ontario.

COST OF TRANSPORTATION BY RAIL

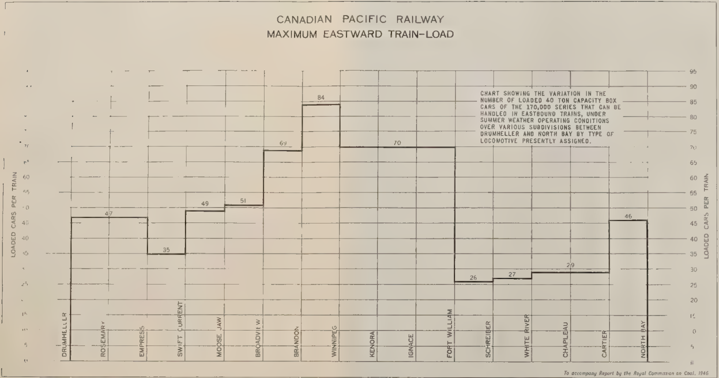
The cost of transporting a given commodity by rail is not susceptible of more than an approximate determination under ordinary railway operating conditions. Only in the case of a railway which handles nothing but coal can the costs per ton-mile for that commodity be ascertained. The first difficulty in

Chart A



To accompany Report by the Royal Commission on Coal, 1946

Chart B



To accompany Report by the Royal Commission on Coal, 1946

estimating the cost of transporting coal is in separating the expenses applicable to all the other commodities transported. It is obvious that expenses involved in collecting a carload of less than carload freight, moving it to a destination and delivering its lading to a number of receivers, are much greater than in receiving, transporting and delivering a car of coal. But both loaded cars move over the same tracks, may be billed by the same agent, and must share general administrative expenses. It is evident that the separation or allocation of expenses as between cars of various commodities is not subject to determination by any mathematical formula. More difficult problems arise in any attempt to ascertain costs of handling the same commodity under the variable conditions that obtain on different railways, and on different portions of the same railways, and on the same portions at different seasons. If there is a movement of coal involving 100 cars per day over a 200-mile route between two points, the cost of handling this traffic per ton-mile is obviously much less than on some other railroad, of comparable physical layout, where only 20 or 30 cars are handled per day.

Where a railway is located in a highly industrialized area, or where there is a steady and heavy flow of traffic, it will generally prosper. These conditions enable the carrier to purchase modern cars and locomotives, to improve its right-of-way, and to provide effective automatic signalling systems, thereby making possible heavy tonnage trains and high speed operation. The cost of transporting the average ton of freight one mile on such railways is at a minimum. Other railways, less fortunately situated, are obliged to survive on a smaller volume of traffic thinly spread over longer distances. The cost per ton-mile on such lines is likely to be greater than on railways more favourably situated. It is therefore evident that the ton-mile costs on a given railway cannot necessarily be used to determine the ton-mile costs on another railway.

A substantial part of Canada's coal is produced in part of the grain-growing area of western Canada. The consequence of this geographic relationship is that the eastward movement of loaded cars greatly exceeds the westward movement throughout the Prairie Provinces and the northwestern part of Ontario. The westward movement of manufactured products and other items consumed in the western provinces is small compared with the tonnage of coal, agricultural and forest products moving eastward. It is evident that such an unbalanced movement, with its inevitably high empty car mileage, is more costly than if the number of loaded cars was more nearly equal in both directions.

East of Winnipeg there are many miles in the Province of Ontario where, aside from trans-lake business, railway traffic is neither produced nor delivered in any appreciable volume. This is virtually barren land from the railroad traffic viewpoint. While such areas exist in the United States, they are not so extensive, and represent a lower percentage of the total territory served by the United States railroads.

RAILWAY FREIGHT RATES—GENERAL

The cost of coal to the consumer is made up of the price paid to the mines for producing it, the price paid to the transportation agencies for moving it to him, and the price paid for marketing or distribution. This section of the report deals with the price of transportation, that is, the freight rates. Particular attention will be directed to the railway rates, because virtually all of the coal consumed in Canada requires rail transportation during part or all of its journey to market. Water transportation enters into the movement of a substantial portion of the coal consumed, and separate attention will, therefore, be given to boat rates.

The general term freight rate embraces the various tolls or charges assessed by carriers for the transportation of freight, and for the miscellaneous services incidental to such movement. Class rates apply generally, in the absence of

any lower basis of rates, on freight of all kinds and between any two points in a wide area. In Canada, all freight is classified into one of ten groups or classes (coal being in the tenth or lowest class) according to certain transportation characteristics, and tariffs provide for rates between any two points in Canada on each of the ten classes, decreasing in level from first class down to tenth class. Among the factors determining the particular classification to which a commodity is assigned are the quantity shipped, the size, weight, fragility, value, shipping characteristics and so on. Only a very small percentage of the railway traffic of North America moves on class rates. Commodity rates are published on specific commodities either from specified origins to specified destinations, or for hauls of various lengths, are on a lower level than the classification rate on the same commodity, and supersede the class rate which would otherwise apply. Specific rates are published by the railways to cover every normal movement of coal and coke in Canada and the United States, and since these rates are substantially lower than the class rates, the classification basis has no real application on coal and coke traffic on this continent.

Class or commodity rates may be local rates between two stations on the line of a single railway, joint rates applicable over the lines of two or more carriers, or proportional rates applicable over the line of one or more railways to or from a junction point or port when the traffic does not either terminate or originate at the junction or port. Specific examples of proportional rates on coal include tidewater and lake cargo rates, applying on coal shipped from inland mines to coal dumping piers at seaboard and lake ports respectively for movement beyond the pier by water, which are lower than rates for delivery on tracks at the same ports; and ex-lake and ex-water rates which apply for rail transportation of freight beyond a port, the coal having had previous water transportation by lake or ocean. The existence of lower proportional rates side-by-side with normal rates between the same two points is based on the conception of such rates as constituting only one factor of the transportation charges covering a through movement, and the regulatory commissions have ruled that such rates may be on a lower level than the normal rate which covers the entire transportation service.

The rate from one point to another may be a through rate, applying as a single factor from origin to destination, or it may be a combination rate, that is, composed of two or more factors, applying to and from a junction point, which, when added together, make up the total freight charge. In some cases, rates are not published specifically, but in the form of mileage rates, where a table of distances is published with varying rates according to the length of the railway haul.

It is necessary for railways to transport a considerable volume of commodities, including coal, for their own use, and this transportation on company service is often designated an "O.C.S." movement. The determination of the appropriate O.C.S. rate has been necessary by the Dominion Fuel Board in the administration of transportation subventions. The Board has used an O.C.S. rate of five mills per ton-mile.

Principles of Rate Making

Railway freight rates are printed and published in freight tariffs, which are in effect the price lists of freight service. To a layman, the huge number of tariffs published by the railways, ranging in size from single sheets to large books, is bewildering. The railways of North America must provide rates to

move practically anything from anywhere to anywhere on the continent, and it is not strange that there are literally millions of freight rates published by the railways of Canada and the United States, and that the railway catalogues, or tariffs, are voluminous and complex.

Some of the basic principles or considerations which appear to influence the determination of freight rates are:

(1) Conformity to the existing rate structure,
(2) Cost of the service to the carrier,
(3) Value of the service to the shipper,
(4) Value of the article,
(5) Nature and quantity of the article,
(6) Competition between carriers, and between producing centres or markets.

(1) Conformity to the Existing Rate Structure

There now exists a structure or pattern of railway freight rates which has evolved over a period of time, modified by the constantly changing forces of commercial needs, competitive conditions and the orders of regulatory bodies. When a railway is called on to establish a new rate, or to change the level of an existing one, such changes have to be made in relation to the existing pattern. Fitting the new rate into the present structure is an important consideration weighed by the railways, because the interests of other shippers may be adversely affected by a drastic departure from the prevailing rate levels and relationships. For example, if a new factory should be established in a particular town, the needs of such a factory might require the creation of special rates to handle the inbound raw materials for the plant and the outbound shipments of the product. If such rates were established without consideration being given to the inbound and outbound rates available to similar factories at other points, the result might well be rates so high as to prevent the new factory from competing with the other plants, or on the other hand so low as to put the other factories out of business. Changes are constantly being made in rates, and the structure itself modified to meet new conditions, but the influence of existing rates on proposed new rates is very strong.

(2) Cost of the Service to the Carrier

While the impracticability of measuring the exact cost of moving a particular article from one place to another by railway has already been discussed, cost of service does enter into the making of rates. Unless the total revenue derived from the transportation services as a whole covers the total cost of performing such services over a number of years railways go bankrupt. This condition affects the general level of rates.

Recognition of the cost-of-service element also determines other features of the freight rate structure. The practice of publishing lower rates for shorter hauls than for longer hauls is, of course, a reflection of differences in the cost of performing the services. The provision of lower rates, per hundred pounds of weight, for carload movement than for less-car-load (L.C.L.) movement of the same commodity between the same points is another. The necessity of providing special types of cars, or special services such as heating or refrigeration for handling certain commodities results in higher rates on these commodities than on others not requiring such services. The prospects of cars being returned empty or loaded may influence the level of the rate published for the loaded movement, and this is a cost element.

While it is not possible to determine accurately all the costs of moving a particular piece of traffic, certain parts of such costs can be measured, and railways do not establish rates below a level which will pay at least these costs. The average earnings of the railroads of North America on their freight traffic as a whole vary from year to year and from railroad to railroad, but are in the neighbourhood of one cent per ton per mile. This is an average, and, of course, some traffic pays more than this amount and some pays less, but in establishing or reducing a freight rate, the railways feel that traffic moved on a rate which yields very much less than this amount may be a drain on their revenues and a burden on other traffic.

Distance as an element in rate-making was touched on above, but requires some elaboration. As one of the simplest rough-and-ready measures of the cost element, it is the principal basis for many rates established by the railways or prescribed by the regulatory commissions. Such rates do not reflect a constant relationship to mileage. There are certain so-called terminal costs of starting traffic and of delivering it at destinations which do not vary greatly whether the road-haul is 10, 100 or 1,000 miles. Many general costs of railway operation do not vary with the length of haul. Since the rate charged by the railway must cover all the costs, terminal, general and line-haul, and the terminal and general costs are a larger proportion of the total costs for short hauls than for long hauls, the rate per ton-mile is invariably higher for the shorter distances than it is as the length of the haul increases. This "tapering" of rates per ton-mile becomes more gradual as the distance increases, and approaches a point where the rate increases in exact proportion to the distance.

This relationship between rates and distances makes it necessary to use caution in making comparisons between rates per ton-mile for different hauls. To draw the conclusion that one rate is on a higher level than another because it reflects greater ton-mile earnings may be erroneous if the lengths of the railway haul are different, and this error is one that is frequently made. Before leaving the subject of rates related to mileage, it is noticeable that many rates on coal on this continent, originally based on mileage, have subsequently been modified to the point where the original structure can hardly be identified. Generally speaking, however, coal rates in Canada show a closer adherence to distance than those within the United States where the multiplicity of railroad routes, competition between producers and between consumers at different points, have subordinated distance as the controlling factor in rate relationships.

(3) Value of the Service to the Shipper

In the adjustment of the relative levels of rates as between different commodities, and also to some extent in determining the actual level of rates on a particular commodity, railways have been largely influenced by the principle of value of the service to the shipper. It costs no more for a railway to move a carload of shoes from one point to another than to move a carload of hay. Based on the cost-of-service theory only, the freight rate on both should be the same. It developed early in transportation history that to provide equal rates for the two commodities did not encourage trade and commerce. The value of the service is considerably greater in the case of shoes than in the case of hay, and the freight rates applied can be and are higher. The value-of-the-service principle has worked out very well in practice and has been repeatedly recognized and approved by government regulatory bodies.

(4) Value of the Commodity

The value of the commodity, as a factor affecting the level of freight rates, is closely allied to the value of the service since, generally speaking, the higher the market value of an article, the greater the value of the transportation service. Market value can be determined much more readily than the value of the

service, and is, therefore, a convenient yardstick to use in setting the relative level of rates on different commodities. As a justification for differences in rates, it has been sanctioned by regulatory authorities.

(5) Nature and Quantity of the Commodity

Under this heading come a number of considerations, some of which involve one or more of the principles already referred to, but which have come to be generally recognized as distinct factors determining relative freight rates. For example, rates are usually lower on heavy materials than on light ones, lower on solid commodities than on liquids, lower on crude materials than on finished products, lower on commodities which do not require protection from extremes of heat or cold than on those which do, lower on shipments which are packaged so as to afford full protection from damage than on those which are not so adequately packed.

Variations in the quantities shipped are also determining factors. Rates per unit of weight are lower when commodities are shipped in carloads than when shipped in less than carload lots, as has already been mentioned. The amount of a commodity which can be loaded in a car frequently influences the rate. The volume of traffic available is a very important consideration, since railways will frequently make lower rates where a large movement is involved than where only a small tonnage is available. There are definite limitations to this practice, however, in that the regulatory laws do not permit discrimination in favour of the large shipper over the small shipper; in fact, it was this practice, carried to excess, which to a large extent led to the creation of regulatory commissions.

(6) Competition

It has been said that freight rates are built on "comparison, competition and compromise". The influence of competition on the freight rate structure has been very strong, and has produced many rate relationships which seem illogical.

While government regulation has put an end to the competitive rate-cutting between railway carriers and secret rebates to shippers, there is still competition in rates between rail-carriers to the extent that between any two points one railway must maintain rates as low as another railway does if it is to participate in handling traffic between the two points. Since not all railways run parallel to each other, this frequently results in the publication of the same rate by two different routes of quite different length. There are a number of complications in adjusting rates of various railways to permit competition between them and it is not necessary to describe these more fully, except to point out that many rates via circuitous routes are lower on a ton-mile basis than they would be if not reduced to meet short-line competition; that the Board of Transport Commissioners permits the railways to meet competition by reducing rates to common points without requiring similar reductions at points served by only one railway; and that the regulatory bodies have generally ruled that it lies within the discretion of a railway whether it will or will not meet competition of other railways for any particular traffic. The existence of competition in one case and not in another, or of differences in the degree of competition in different cases, frequently results in differences in rate levels.

Competition between railways and water-carriers has affected many railway rates, and there are a great number of instances where the railways have departed from the distance principle to secure business at points where water transportation was available. Competition between railways and trucks has in recent years resulted in the reduction of many rail rates below their normal level, particularly in the case of rates for the shorter hauls.

All these competitive forces have had an influence on the general railway rate structure and the level of particular rates. Many apparently illogical rates are the result of competitive pressures, and some freight rates on coal are among them.

Government Regulation of Freight Rates

The regulatory body having jurisdiction over railways in this country is the Board of Transport Commissioners for Canada. The law which the Board administers comprised principally the Railway Act, Revised Statutes of Canada, 1927, the Transport Act of 1938, and the Maritime Freight Rates Act of 1927. Effective regulation of railways in Canada began with the passing of the Railway Act of 1903 by Parliament, creating a Board of Railway Commissioners and prescribing certain rules and standards to which railway rates and practices must conform. By the Transport Act of 1938 the name of the Board was changed to Board of Transport Commissioners. The equivalent regulatory body in the United States is the Interstate Commerce Commission, established by the Interstate Commerce Act of 1887. The railway regulatory laws of both countries were founded on laws in effect in Great Britain, and have been amended on a number of occasions as the need for changes became evident.

The primary purpose of regulation was to protect the public against unreasonable rates and practices, unjust discrimination as between shippers, between different localities, and between different commodities or types of traffic; to provide for adequate railroad service; and to ensure that all changes in rates and rules were given proper publicity and advance notice. Prior to the creation of the regulatory commissions, many abuses had developed to railroad practices which not only resulted in injustices as between different shippers but produced a chaotic situation in commerce, since rates fluctuated from day to day and no shipper knew what his rates would be at any time or what those of his competitor were or would be.

The Board of Transport Commissioners is composed of six members appointed by the Governor in Council, each for a term of ten years and eligible for reappointment. The Board is a court of record and has all the powers of a superior court as regards the attendance and examining of witnesses, the production and inspection of documents, and the enforcement of its orders. Its decisions and orders are public documents, are published in the Board's Judgments, Orders, Regulations and Rulings, and many of them are published in a series of reports cited as Canadian Railway and Transport Cases, formerly Canadian Railway Cases. The Governor in Council may either on petition or of his own motion amend or rescind any order of the Board, and any order of the Governor in Council is binding on the Board and on all parties. The right to appeal to the Governor in Council has been exercised in only a very few cases. Except for intervention by the Governor in Council, the Board's findings or determinations as to matters of fact within its jurisdiction are final. Its decisions and orders may, however, be appealed to the Supreme Court of Canada on any question of law or jurisdiction. The Board's jurisdiction extends in general over all steam railways in Canada with the exception of a few provincially-owned lines, chiefly the Ontario Northland and Pacific Great Eastern Railways. The Transport Act of 1938 gave the Board authority over water-transport agencies operating between Canadian ports on the Great Lakes and the St. Lawrence River west of the Island of Orleans. The jurisdiction does not, however, apply to bulk commodities handled by water carriers and therefore excludes the movement of coal, grain and ores which move as bulk cargoes. Insofar as railways are concerned, the Railway Act vests in the Board a number of powers over construction of lines, location of stations, building of bridges, highway crossings, type of equipment, and the like.

From the standpoint of this report, the Board's control over rates is its most important function. The Railway Act provides that rates shall not be unreasonable, unjustly discriminatory, unduly preferential or prejudicial; empowers the Board to determine whether particular rates violate these provisions and to disallow rates which it considers to be unjust or unreasonable. The Board does

not initiate rates—that lies with the railways—but once rates are filed the Commissioners can examine them, either on complaint or of their own motion, and can order them changed if found to be unlawful. The Board cannot, however, order changes in freight rates unless they infringe the provisions of the law.

Complaints may take the simple form of a letter from a shipper, and a large proportion of rate complaints are settled through exchange of correspondence between the Board, the complainant and the railways. On the other hand, formal complaints may be made, hearings held at which testimony is received from any interested party, and formal decisions rendered by the Board. Such hearings may be, and actually are, held in any part of Canada. The more important cases affecting coal rates are described in the next section.

BASIS AND EVOLUTION OF COAL AND COKE RATES

Within Canada

At the risk of repeating what has been said elsewhere in this chapter, it might be emphasized here that special commodity rates are published by the railways to apply on all railway movements of coal and coke in Canada. These rates are considerably lower than the lowest class rates. They are published with regard to the particular conditions affecting the marketing of coal and coke in different parts of the country, and do not in general reflect a definite or fixed relationship either with mileage or with rates on other commodities. Some of the rates have been fixed by the regulatory authority, and others have been voluntarily established by the railways.

The filing in 1904 of the railway freight rate schedules with the then Board of Railway Commissioners subjected these schedules or freight tariffs to complaint and investigation, and in due course of time to the fixing of rates by the Board. The two investigations of the Board, which initially fixed the level of freight rates (including coal and coke) in eastern Canada and western Canada, are the Western Rates Case decided in 1914 and the Eastern Rates Case in 1916. About ten years later the Dominion Government, by Order in Council P.C. 886 of June 5, 1925, directed the Board of Railway Commissioners to make a country-wide investigation of railway freight rates, and after two years of hearings the Board, in 1927, issued its judgment and order in this general freight rate investigation. A brief digest of the reasons for and the results of these investigations is given herein for the purpose of an understanding of the present freight rates on coal and coke.

Western Rates Case

The first step leading up to the enquiry into western freight rates was a resolution of the Winnipeg Board of Trade passed on November 14, 1911, which held that the rates charged for the carriage of freight from Winnipeg and throughout the whole western territory were based on a much higher scale than those charged for similar service in the Provinces of Ontario and Quebec. The resolution was adopted by other Boards of Trade in the western provinces and was forwarded to the Minister of Railways and Canals, who referred the question to the then Board of Railway Commissioners.

As a result of the representations made, the Board on January 8, 1912, ordered that a general enquiry be undertaken by the Board into all freight rates in effect in the Provinces of Manitoba, Saskatchewan and Alberta and in Ontario west of Port Arthur, and subsequently extended the enquiry to cover rates in British Columbia. In its decision, the Board concluded that the western rates were not unjustly discriminatory, but that many of them were unreasonable as

measured by the traffic necessities of western Canada, and a fair rate of return to the railway carriers as a whole. A number of important changes in the rate structure were ordered.

Dealing with coal, the Board found that some of the rates were too high and should be reduced to a basis as low as could be consistently directed, having regard to the character of the commodity and the general practice of the carriers in establishing low rates on low-grade commodities, particularly coal. Accordingly, reduced rates were prescribed from Lethbridge and Cardiff in Alberta, and from Bienfait and Estevan in Saskatchewan, to a number of specified destinations. The rates specifically ordered were to serve as a guide for revising coal rates to other destinations and from other origins, and while the Board did not state the basis for the reductions or for the rates set forth in their order, they were actually about 55 per cent of the tenth class rates in the case of the Alberta mines and 50 per cent of the tenth class rates from the Saskatchewan origins.

The Board approved the principle of grouping mines within a reasonable distance of each other and applying a common rate from all mines in the group to destinations more than 100 miles distant, the rate to be based on the distance from the mine nearest to the destination. Where joint through rates over the lines of two carriers were published, it was ordered that such rates should not exceed by more than 20 cents per ton the rate which would have been applicable if the through mileage had been that of a single railway.

Eastern Rates Case

The Eastern Rates Case was initiated in 1916 by the Canadian Freight Association on behalf of all railway companies in eastern Canada under the jurisdiction of the then Board of Railway Commissioners for a general increase in freight rates. A number of shippers, Boards of Trade and other organizations intervened in opposition to this application on various grounds, and the Board broadened the case to include a study of the existing rate structure, as well as the merits of the application for a general increase in the rates.

Without going into detail as to the Board's findings, it may be said that in general the Board approved the proposed rate increases with certain modifications. As to coal rates, on which an increase of 10 cents per ton had been sought, they authorized increases of 10 per cent in the rates, with a maximum increase of 10 cents per ton. At the same time, as a result of their general study of the prevailing rates, they ordered a substantial revision of the rates published on coal from the Niagara Frontier and Detroit to destinations in Ontario and Quebec, primarily to correct relationships between the rates to different destination groups so as to form "a more symmetrical blocking". The effect of these changes was, first, that in many cases the rates were increased by less than ten cents and in some cases actually reduced; second, the destination groupings and relationships were fixed by regulatory order; and finally, that the rates specified became prescribed maximum rates, not subject to increase by initiative of the carriers. In the case of rates on coke, the railways applied for a blanket increase of 10 cents per ton in the existing rates, and this was granted by the Board. They required, however, the same regrouping of destinations as in the case of coal, which resulted in some rates receiving less increase than the 10 cents authorized generally.

General Freight Rates Investigation

During 1925-1927, the then Board of Railway Commissioners, by direction of the Dominion Government, conducted a general freight rate investigation with a view to the establishment of a fair and reasonable rate structure which would, in the language of Order in Council P.C. 886, dated June 5, 1925, "under sub-

stantially similar circumstances and conditions, be equal in its application to all persons and localities, so as to permit of the freest possible interchange of commodities between the various provinces and territories of the Dominion, and the expansion of its trade, both foreign and domestic". Notice of the investigation to be undertaken was given to the provinces, industrial organizations and to the public generally, and all parties were invited to appear before the Board and make such submissions and representations as to them seemed expedient with respect to any and all rates with which they were dissatisfied. Reference to the Board's judgment, reported in 17 J.O.R. and R. at pages 131-422, indicates that three complaints relating to coal were received.

The judgment left the basis of coal and coke rates generally as prescribed by the Board in the Western Rates Case and the Eastern Rates Case, but subject to general increases and reductions in all freight rates authorized by Orders of the Board in 1918, 1920, 1921 and 1922.

Present Rates

The general level of Canadian freight rates has not been changed since 1922. In 1941 all freight rates, including those on coal and coke, were "frozen" by Order 92 of the Wartime Prices and Trade Board.

Before undertaking a description of the present Canadian coal and coke rate basis, it must first be explained that originally the railways made their rates on coal, as on other commodities, on purely a distance basis by means of so-called mileage scales which specified the distance between stations on the railways, and the rate charged for each distance was set forth against the mileage. The mileage rates progressed in regular steps, usually 10 cents per ton for each succeeding distance, and in 5, 10 or 25 mile blocks. These mileage scales are still in existence, but as the country developed, such simple scales were too rigid in many cases, especially for the longer hauls, and it was necessary to depart from the scale to make individual or specific rates between various points to meet vessel competition and market or commercial competition, or to place groups of mines on one rate basis not especially related to distance so that several mines in one geographical location might compete with each other at the same rate in a common market. Thus, there are now within Canada, or from the international boundary to Canadian points, literally thousands of coal rates, each of which has been established for one of the particular reasons just outlined.

Obviously these rates cannot be described individually in the scope of this chapter, but an effort will be made to state in brief form the general character of the various coal rate schedules. This must be done in a regional manner, due to the well-separated geographical location of the coal deposits in Nova Scotia and New Brunswick in the east, the Saskatchewan, Alberta and British Columbia deposits in the west, and the United States deposits adjacent to the Central Provinces.

Maritimes

The Intercolonial Railway, extending from the Maritime Provinces to Montreal, was operated until 1923 under the authority of the Minister of Railways and was free until 1923 to fix rates in accordance with the economic situation of the Maritime Provinces without any regulatory control by the then Board of Railway Commissioners. Freight rates in the earlier days of the Intercolonial were influenced by Government policies with respect to Confederation obligations, and so continued until 1912, when the Dominion Government instituted a different form of administration on the Intercolonial, which endeavored to adjust the rates to a self-sustaining basis. This resulted in dissatisfaction on the part of

shippers, and the appointment of the Royal Commission on Maritime Claims to investigate, amongst other things, the situation with respect to freight rates. Following the report of this Commission, legislative action restored the rate schedules which the Maritime Provinces had formerly enjoyed by requiring on July 1, 1927, a reduction of approximately 20 per cent in the freight rates within the Maritime Provinces and for that portion of the rate accruing in those provinces on traffic destined beyond Levis. The reductions in rates so made do not decrease railway revenue since the Dominion Government pays the difference between the statutory rates and the normal rates to the railways. Two examples of the present rates are: from Sydney to Halifax the rate on coal is $1.60 per net ton for 290 miles; to Saint John $1.90 on coal and $1.85 on slack for 432 miles.

There are also through rail rates from the Maritimes to Quebec and Ontario which are low for the distance involved; for example, from Sydney to Quebec $3.20 for 817 miles; to Montreal $3.80 for 956 miles; and to Ottawa $4.60 for 1,063 miles. These rates, despite their low level relative to distance, are not important, as the cost of water transportation from Sydney to Quebec or Montreal, added to the rail rates beyond, makes a much lower combination than the all-rail rate. The water rates fluctuate considerably and much coal is not carried at quoted rates but is transported in company vessels, for which the costs are not specified. However, assuming a water rate of 61 cents per ton from Sydney to Montreal, with handling charges at the ports amounting to 41 cents and adding the rail rate from Montreal to Ottawa of $1.10, the total is $2.12 per ton compared with the rail rate of $4.60 per ton.

Quebec and Ontario

The western portion of the Province of Quebec and much of Ontario are in relatively close proximity to the coal fields of the United States, and a great part of this area secures its supplies from United States points. So far as bituminous coal is concerned, the coal is largely delivered by vessel via cross-lake routes or down the St. Lawrence River to the Canadian lake and river ports. To some extent, however, the coal moves all-rail from United States coal fields to the Canadian destinations. These circumstances have resulted in the Canadian railways making proportional rates on coal from the St. Lawrence River ports, from the Canadian lake ports and from the junctions with the United States railways along the boundary. The rates from Quebec and Montreal also apply generally on coal produced in Nova Scotia and New Brunswick. For example, the rate from Montreal to Sherbrooke is $1.30 for 101 miles; to Ottawa $1.10 for 117 miles; to North Bay $2.60 for 340 miles; to Copper Cliff $2.80 for 445 miles, and to Noranda $3.20 for 543 miles. From Buffalo to Hamilton the rate is 90 cents per net ton on bituminous coal and $1.05 per gross ton on anthracite coal for a distance of 61 miles; to Toronto the rate is $1.00 per net ton on bituminous and $1.15 per net ton on anthracite for a distance of 101 miles; to London the rate is $1.40 per net ton on bituminous and $1.65 per gross ton on anthracite for a distance of 132 miles; to Sudbury the rate on bituminous is $2.80 per net ton and on anthracite $3.00 per net ton for a distance of 356 miles. From Detroit to London the rate on bituminous coal is $1.10 per net ton for a distance of 112 miles; to Hamilton $1.40 per net ton for 192 miles; to Toronto $1.40 per net ton for 227 miles, and to Sudbury $3.10 per net ton for 476 miles.

Head-of-the-Lakes

Rates on ex-lake coal from Port Arthur and Fort William, when originally established, were influenced by competitive shipments of coal to Prairie points from Duluth, a shorter distance than from Port Arthur or Fort William. At the present time the prevailing rate from the Head-of-the-Lakes to Winnipeg is $3.30 per net ton on both anthracite and bituminous for a distance of 424 miles.

Prairie Territory

Comment has already been made on the order of the Board of Railway Commissioners in 1914, prescribing a reduced basis of rates on coal on the Prairies equal to 50 per cent of the tenth class rates from Saskatchewan mines and 55 per cent from Alberta mines, and on the fact that these mines were grouped in well-defined areas based on their geographical location and the type of coal produced. The general increases permitted by the Board based on increased railway costs in 1918-1920, were lower on coal than on the tenth class rates, so that the present rates on the Prairies are on a relatively lower percentage of tenth class rates than originally prescribed by the Board. From Estevan to Winnipeg the rate now is $2.30 per net ton for a distance of 291 miles; from Drumheller to Saskatoon the rate is $2.80 for a distance via Canadian National of 315 miles and via Canadian Pacific 576 miles; to Winnipeg $4.70 for a distance of 783 miles; and to Port Arthur $6.50 for 1,220 miles.

Agreed charges have been put into effect in Saskatchewan from the Estevan and Bienfait fields to points relatively close to the mines in order to assist the railways in meeting truck competition. The rates are especially low but are only available to shippers upon an undertaking to use railways exclusively. In Alberta, to meet truck competition, the railways have had recourse to special truck-competitive rates on a level considerably lower than the generally prevailing rates.

British Columbia

The general basis for coal rates in British Columbia was laid down by the Board of Railway Commissioners in the Western Rates Case previously described. There have been some modifications of this basis—for example, rates have been established from Alberta mines on the Coalspur Branch of the Canadian National Railways to Vancouver, B.C. which reflect the application of 6 mills per ton-mile to the through distance, and it appears that this rate was made to assist in the marketing of Alberta steam coal in competition with coal shipped from Vancouver Island by boat. As an example, the rate from Coalspur to Vancouver is $3.90 per ton for 663 miles, this rate being applicable for Canadian National Railways delivery. This coal is principally delivered on C.P.R. tracks, and there is an additional switching charge of 20 cents per ton; the total rate for Canadian Pacific Railway delivery is $4.10 per ton. The rate to Vancouver from Drumheller is $5.00 per ton for 741 miles via the Canadian Pacific and 943 miles via the Canadian National; from Lethbridge the rate to Vancouver is $5.00 per ton for 769 miles.

Alberta to Ontario

Rates from mines in Saskatchewan, Alberta and British Columbia to points in Ontario as far east as Port Arthur and Fort William have been in effect for many years, on a basis reflecting the Board's order in the Western Rates Case. As example, the rates to Port Arthur are $4.30 per ton from Estevan, Sask., for 715 miles via C.P.R., 741 miles via C.N.R., $6.30 from Lethbridge, Alta., for 1,181 miles, $6.50 from Drumheller, Alta., for 1,220 miles, $6.80 from Michel, B.C., for 1,295 miles, and $7.20 from Coalspur, Alta., for 1,403 miles.

In 1923, rates were extended to destinations east of Port Arthur, the rates from Drumheller, for example, being $10.90 per ton to North Bay for 1,797 miles; to Toronto, Hamilton, Ottawa and Windsor the rate is $12.70 for distances of 1,990, 2,028, 2,023 and 2,197 miles respectively. Rates from other points of origin vary, depending on their location, as in the case of rates to Port Arthur. In 1933, the railways established what might be called a "subvention rate", which will be specially dealt with later in the chapter. This rate is $8.00

per ton, applies to a large group of Ontario destinations extending as far east as Ottawa and Cornwall, and is carried as a uniform rate from substantially all mines in Alberta and the Crowsnest Pass District of British Columbia.

Anthracite Rates

Most of the foregoing matter relates to bituminous coal rates, with only incidental reference to rates on anthracite. United States anthracite for Canada is mined in only one locality, eastern Pennsylvania, and a different transportation situation exists with respect to that coal. Generally speaking, there are joint through rates via the routes through and east of Cobourg, Ontario, but via the Buffalo and Detroit gateways the rates are published separately south and north of the boundary. Rates are also published where necessary to handle shipments from the lake ports to inland destinations. Some examples of rates on anthracite coal within Canada have already been given, and further detail with respect to these rates is considered unnecessary. The subject of through rates from the United States to Canadian destinations is dealt with more fully in another section of this chapter. Anthracite rates in both Canada and the United States are generally slightly higher than those applying on bituminous coal, reflecting the higher value of anthracite.

Coke Rates

While the major part of the coke produced in Canada is consumed at the point of production or is distributed locally without the use of railway transportation, the rail movement of coke both from Canadian producing points and from across the United States border is of sufficient importance to warrant mention of the rates provided on such movements. The principal plants shipping by rail are at Sydney, Montreal, Hamilton, Sault Ste. Marie, Coleman, Michel and Vancouver. The railways maintain specific commodity rates on coke from these points to destinations in their normal market areas. Rates are also published from the Detroit, Niagara Frontier and Adirondack junctions with the United States lines to destinations in eastern Canada, and from Port Arthur, Fort William and Duluth to points in western Ontario, Manitoba and Saskatchewan.

Generally speaking, rates on coke are somewhat higher than rates on coal, since coke is more bulky, the average load per car is less, and the value of coke is usually higher than that of coal. This difference was accentuated in Canada by General Order No. 308 of the then Board of Railway Commissioners in 1920, which, in granting increases in rates limited the increases in the case of coal rates but permitted the general increase of 35 per cent to be applied on coke.

From the United States to Canada

Section I of this chapter has described the channels through which coal produced in the United States reaches Canada. In dealing with the rates applying on the movement via these routes, it may be observed that with insignificant exceptions they are an integral part of the structure of rates applied on the movement of coal within the United States and are not specially designed for the shipment of coal to Canada, that they reflect the existence of competition between a number of United States railroads and between thousands of coal producers, and that most of them have been either prescribed or specifically approved by the governmental authority having jurisdiction over railroad rates in the United States.

To avoid confusion, the rates stated herein are those in effect immediately prior to July 1, 1946. In response to a petition by the United States railroads for an immediate increase in freight rates, the Interstate Commerce Commission granted temporary increases taking effect July 1, 1946, and hearings on the request for a permanent increase are pending at the time of writing.

Lake-Cargo Rates

On the south shore of Lake Erie there are elaborate facilities maintained by the railroads for the assembling and transfer of coal from cars to boats at a number of ports from Buffalo, N.Y., in the east, to Toledo, Ohio, in the west. These ports handled 6.7 million tons of coal destined to Canada in 1939 and 12.2 million tons in 1944. The two most westerly ports, Sandusky and Toledo, handle the largest tonnage, most of which originates in the so-called southern fields—that is, in Virginia, southern West Virginia, eastern Kentucky and Tennessee. The freight rates for this movement are $1.91 per net ton from one group of origin districts which ship high volatile coal and $2.06 per net ton from another and more distant group of mines shipping principally low volatile coal.

The principal district in Ohio, so far as the lake trade is concerned, is in the eastern part of the State, being generally known as the Ohio No. 8 District, and the rate from this district to various Lake Erie ports is $1.53 per net ton. The Pittsburgh district of southwestern Pennsylvania has a rate of $1.56, and the Fairmont district of northern West Virginia a rate of $1.76 to most of the ports from Erie, Pennsylvania, to Sandusky, Ohio, inclusive. The Reynoldsville district of western Pennsylvania carries a rate of $1.56 from certain mines to Buffalo, N.Y., and Fairport, Ohio. There is a dumping charge of 9 cents per ton for transferring the coal to boats at all the Lake Erie ports, which is in addition to the rates shown. This is not a complete list of all the lake-cargo rates to the Lake Erie ports, but it covers the principal movements so far as coal reaching Canada is concerned.

On Lake Ontario there are railroad-owned coal dumping piers at Charlotte, Sodus Point, and Oswego, N.Y. These docks handled in 1939 about one million tons and in 1944 about two and three-quarter million tons of bituminous coal destined to Canada, and slightly less than 300,000 tons of anthracite in both years. Canada is the principal market for coal handled over these piers, and the coal originates in central and western Pennsylvania and in northern West Virginia. Rates from some districts to the Lake Ontario ports are published on a gross ton basis, but for purpose of comparison we have shown the rate per net ton to which the gross ton rates are equivalent. The principal rates are: from the Clearfield and Reynoldsville districts of central Pennsylvania $1.68 per net ton; from the Westmoreland district, which includes the Pittsburgh district of western Pennsylvania and the Fairmont district of northern West Virginia $1.90 per net ton; both rates being subject to a dumping charge of 9 cents per net ton.

The lake-cargo rates described are on a lower level than local rates. For example, while the Pittsburgh district rate to Cleveland, Ohio, for lake-cargo movement is $1.56, the rate for delivery to industries or dealers at Cleveland is $1.94. In part, this difference represents a proportional rate as compared with a local rate, since the lake-cargo rate only becomes applicable when there is a further movement beyond the port by water. A further contributing factor is the competition between the different fields and between the different railways.

A new development in the flow of lake-cargo coal was the publication in 1941 of lake-cargo rates from mines in Illinois, Indiana and western Kentucky to Chicago, and the construction of facilities for transferring coal from cars to boats at that point. These rates were established to permit coal produced in the midwestern fields to compete with eastern coal at the ports on the upper lakes, and are lower than the rates for delivery to consumers at Chicago by varying amounts. The rate from the southern Illinois district is $1.65 per ton for lake movement, compared with $2.05 for track delivery. From western Kentucky the lake-cargo rate is $1.90 and the track delivery rate $2.30. Chicago is a highly competitive market and the rail rates for track delivery reflect this competition.

All-Rail Rates

Detroit—Windsor Gateway

Bituminous coal shipped to Canada through Windsor moves on a combination of rates published from the mines to Detroit plus the rates published from Detroit by the Canadian railways. The coal originates mainly at mines in Ohio, West Virginia and Kentucky, and includes both high and low volatile coals. Some of the rates to Detroit are: $2.20 per ton from the principal Ohio fields, $2.70 per ton from the southern high volatile fields, and $2.95 per ton from the southern low volatile districts. The same rates apply on coal shipped to Detroit for use in that city.

Niagara Frontier Gateway

Generally, the rates on coal moving via the Niagara Frontier are based on combination of rates to and from the border points. The principal bituminous coal origin districts and the applicable rates to the Niagara border junctions are: Reynoldsville district $2.19 per net ton, Pittsburgh district $2.34 per net ton, Connellsville $2.49 per net ton, and Clearfield $2.34 per net ton, all these districts being in Pennsylvania; and the Fairmont district in northern West Virginia $2.49 per net ton. These are the same as the rates to Buffalo for local delivery.

Car-Ferry Routes

Through rates are published on coal from mines on certain railways in the United States to destinations in Ontario and Quebec via the car-ferry routes but, with minor exceptions, the through rates are the same as the combination rates via the border gateways and were published as single-factor through rates partly as a convenience and partly to avoid technical difficulties in equalizing rates via the ferry routes with those in effect via the all-rail routes.

Adirondack Junctions

There is a general arrangement of through rates now published by various United States railroads on coal from the Pennsylvania and northern West Virginia fields to destinations in eastern Ontario, Quebec, and a number of points in the Maritimes applying via several gateways, principally junctions between Canadian and United States lines between Prescott, Ontario, and Ogdensburg, N.Y., on the west, and such points as Vanceboro, Maine, on the east. Originally, rates on United States coal to this territory were based on combinations made up of proportional rates to the gateway plus rates of the Canadian lines beyond. These rates to and from many of the gateways are still in effect. Since these gateways are not all close together, it was found difficult to maintain combinations which would provide equal rates via all the routes involved, and in order to have such equality through rates were published applying via various junctions to a wide destination territory. A few examples of the through rates on bituminous coal are:

Origin District	Destination	Published Rate per Gross Ton	Equivalent Rate per Net Ton
		$	$
Clearfield (Central Pennsylvania)	Ottawa, Ont.	4.50	4.02
Clearfield	Sherbrooke, P.Q.	5.20	4.64
Clearfield	Montreal, P.Q.	4.60	4.11
Westmoreland (Western Pennsylvania, Northern West Virginia)	Ottawa, Ont.	4.75	4.24
Westmoreland	Sherbrooke, P.Q.	5.45	4.87
Westmoreland	Montreal, P.Q.	4.85	4.33

Tidewater Rates

Special trans-shipment rates are published on coal from mines in Pennsylvania, Maryland, and northern West Virginia to New York, Philadelphia and Baltimore, and from mines in Virginia, southern West Virginia and eastern Kentucky to the Hampton Roads piers. The movement to Canada through these piers does not appear to be substantial enough to warrant a discussion of the rates.

Rates on Anthracite

The entire production of anthracite is limited to a small area in eastern Pennsylvania and, while it is shipped to Canada in considerable volume, the channels through which it moves are much more restricted than for bituminous coal. Some anthracite is shipped over the lakes, principally through the Lake Ontario ports of Oswego, Sodus Point and Charlotte, while a smaller tonnage moves through Lake Erie ports. The all-rail rates handle considerably more tonnage to Canada than do the lake-cargo rates. As in the case of bituminous coal, the basic framework of the rates is the combination to and from the border points, but a number of through rates have been published in order to permit the traffic to move by several different routes. In addition to this, special reductions were made in the rates to Toronto, Montreal and Quebec in 1933, to meet the competition of water-carriers. A few representative examples of the through charges on prepared anthracite are shown below:

—	Per Gross Ton	Per Net Ton
	$	$
To Quebec	4.61	4.12
To Montreal	4.11	3.67
To Toronto	3.91	3.49
To Hamilton	3.76	3.36
To Peterboro	5.31	4.74
To North Bay	5.98	5.34

Rates on Coke

Normally, a large part of the United States coke imported into Canada originates at by-product coke plants at the border cities, Detroit and Buffalo. During World War II and at times during the fuel shortage since the war there have been movements of coke in some volume from various United States sources. Most of this coke moves on combination rates made to and from the border junctions, but there are a limited number of through rates published, particularly from the beehive coke districts of southwestern Pennsylvania via the Adirondack gateways. The movement is not of such importance as to warrant an extended consideration of the rates. Shipment of coke by lake has not attained any great volume, and there is no special basis of rates published from United States coke-producing points to the lake ports for movement by water. Water competition has, however, affected some railway rates from the border cities to Canadian destinations.

From Canada to the United States

From a tonnage standpoint, the movement of coal from Canadian mines to markets in the United States is not important. However, the existence of consuming areas across the border and reasonably close to certain coal fields of Canada has led to some speculation as to the possibility of increasing exports to the United States. The subject is dealt with in the chapter on Markets, and we are here concerned only with the railway rates provided for such movements.

The present market for Maritime coal in the United States is limited to a few points in Maine, adjacent to the international boundary. There are through rates from the Minto field to a few Maine destinations, but in general, the available rates are made up of combinations of proportional rates from the New Brunswick and Nova Scotia mines to border junctions, plus rates of the United States railroads from the junctions.

There is a sizeable movement to the States of Washington and Idaho from mines in the Crowsnest Pass district. The Canadian Pacific Railway, with the co-operation of the Spokane International Railroad, publish through rates from mines in the Crowsnest Pass to a number of points in Idaho, Oregon and Washington.

Vessel Rates

We have pointed out the importance of water transportation in the movement of coal in and to Canada. The economy of large-scale vessel transportation for bulk commodities of relatively low value such as coal is well known and is reflected in the freight rates for vessel transportation of coal.

Vessel rates for movement of a commodity from one port to another are very strongly influenced by the volume of traffic moving in the reverse direction. The substantial tonnage of coal brought to Canada from the United Kingdom prior to the war was handled very cheaply because the amount of traffic moving eastward across the Atlantic greatly exceeded the westbound movement and vessel owners made low rates for the carriage of coal, in preference to returning to North America in ballast. A similar situation exists in connection with the movement of coal from ports on the lower lakes to points on the upper lakes, since there is a heavy movement of grain and iron ore from the Lake Superior ports to Georgian Bay and Lake Erie ports.

The charges assessed by vessel carriers are not ordinarily published in tariffs or paid by all shippers alike. For shipment on the Great Lakes there is a certain uniformity and stability in the rates, but even for this movement there may be differences in the terms arranged between the vessel owners and various individual shippers or receivers, or between the charges during different parts of the shipping season. Shipments by water from Sydney prior to the war were partly in colliers owned by the coal company and partly in chartered vessels. Coal shipments from overseas are in chartered vessels.

During the war there was a complete disruption of ocean-going transport, and the effects were felt on the Great Lakes. Rates charged by Canadian vessels operating on the Lakes were set by the Wartime Prices and Trade Board, at a level slightly higher than those applying in 1939. Much of the lake coal tonnage moved in vessels of United States registry which were not subject to control of the Wartime Prices and Trade Board, and there were moderate increases in their rates. There has been an increase in the number and aggregate capacity of the bulk cargo fleet on the lakes. The number of canal-size freighters has been materially reduced. The sea-going cargo fleet owned by United States interests has increased enormously, while there has been a marked reduction in the number of vessels of other registry. Costs of construction, of uel and supplies, and the wages of crews have gone up very considerably. In view of these and other circumstances, we are unable to foresee at what levels the boat rates will finally stabilize, although it seems altogether likely that they will be generally somewhat higher than before the war.

From Sydney, the pre-war cost of shipping to Montreal was about 61 cents per net ton. To Quebec the cost was approximately 50 cents, and to Three Rivers about 55 cents. Rates from Pictou were about 5 cents lower than

from Sydney to Montreal, while to other St. Lawrence River destinations they were in some cases a few cents lower and in others a few cents higher than the Sydney rates. Rates for movement from Montreal in "canalers" were about 55 to 60 cents to Toronto and Hamilton, approximately 70 cents to Welland and Windsor and about 75 cents to Georgian Bay ports. The speed at which the boats can be unloaded at different ports affects the rates. For instance, coal to Belleville, Ont., was carried at a rate of $1.00, although lower rates were applied on coal moving to ports further west.

Rates from ports in the United Kingdom to Montreal were in the neighbourhood of $2.00 per net ton, and the rates for furtherance from Montreal approximately the same as in the case of coal originating in Nova Scotia. Some coal moved from Mariupol in Russia at rates of about $4.80 per net ton.

From the ports on Lake Ontario, rates ranged at about 30-40 cents to Toronto, 35 cents to Prescott, 70 cents to Montreal and 80 cents to Quebec. Rates in self-unloaders, including the dumping of coal on the dock, were generally slightly higher than those shown. Rates to Montreal were about 85 cents from the western ports on Lake Erie and 75-80 cents from the eastern ports. Rates to Toronto and Hamilton were from about 40-60 cents, depending on the port through which the coal was shipped, and also whether it moved in bulk carriers or self-unloaders. To ports on the Ontario shore of Lake Erie rates ran from 28 to 45 cents, and to Windsor between 25 and 35 cents. Rates to Georgian Bay were about 40 cents, to Sault Ste. Marie approximately 35 cents and to Fort William about 40 cents per ton.

The pre-war rates on scow movements from Vancouver Island to Puget Sound points were as follows:

Nanaimo to Seattle	$0.60
Nanaimo to Bremerton	1.00

Union Bay to the above points about 10 cents higher.

By comparison with railway rates for comparable distances, the vessel rates described are low. They do not, however, cover the total transportation charges applicable to the movement of coal by vessel in Canada. Virtually all the waterborne coal requires rail transportation from the mines to the docks where it is loaded in steamers. In the case of Nova Scotia coals, the initial railway movements are quite short and the charges range from 12 to 25 cents per ton. Most of the coal shipped from Great Britain moves relatively short distances to the ports. Coal imported by lake from the United States requires rail hauls of varying lengths, usually several hundred miles, and the freight rates charged have already been discussed. The rates applied for the railway portions of the haul must, of course, be added to the vessel rates to determine the transportation charges to the ports of destination. There are also charges for dumping coal from cars to vessels, additional charges or costs for unloading from vessels to docks (except in the case of self-unloaders whose rates usually include discharge to the docks), and costs for reloading to trucks or railway cars. At some ports wharfage charges are assessed. Since waterborne coal can only move during the season of open navigation while much of the consumption is during the winter months, coal must be stored on the docks or at the point of consumption, which involves storage costs, insurance, interest on inventory, and so on. In the case of coal which must be marketed in the larger sizes, the additional physical handling incidental to the movement of waterborne coal results in degradation or breakage and the necessity of rescreening the coal on the docks, and disposing of the screenings at a lower price than the screened coal, often at a loss. This factor is of special importance in the case of anthracite and helps to explain why the bulk of this coal imported from the United States is shipped all-rail.

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There are shown in the following table, a few examples of approximate transportation and handling costs to representative destinations, also the corresponding all-rail rates prevailing in 1939, exclusive of transportation subventions:

EXAMPLES OF APPROXIMATE TRANSPORTATION AND HANDLING COSTS IN 1939

(Rates per net ton)

	To			
From Glace Bay, N.S.	Montreal	Ottawa	Toronto	Kitchener
	$	$	$	$
Rail rate to port	0.25	0.25	0.25	0.25
Dumping to vessel	0.10	0.10	0.10	0.10
Vessel rate	0.61	0.61	0.61	0.61
Handling at Montreal	0.31	0.31	0.25	0.25
Rail from Montreal	....	1.10	....	....
Boat from Montreal	....	....	0.55	0.55
Handling at Toronto	....	....	0.47	0.47
Rail from Toronto	....	....	....	1.20
Total	1.27	2.37	2.23	3.43
Rail rate to Sydney	0.25	0.25	0.25	0.25
Rail rate from Sydney	3.80	4.60	5.20	5.70
Total rate, all-rail	4.05	4.85	5.45	5.95

	To			
From Pittsburgh District	Montreal[1]	Ottawa[2]	Toronto[3]	Kitchener[4]
	$	$	$	$
Rail rate to port	1.90	1.90	1.56	1.56
Dumping to vessel	0.09	0.09	0.09	0.09
Vessel rate	0.65	0.35	0.42	0.24
Discharge and Handling	0.47	0.10	0.30	0.25
Rail rate from port	....	1.08	....	1.40
Total	3.11	3.52	2.37	3.54
All-rail rate	4.33	4.24	3.34	3.74

[1] Via Sodus Point [2] Via Sodus Point and Prescott [3] Via Cleveland
[4] Via Cleveland and Pt. Burwell

The vessel rates have all advanced since 1939, and the increase in the case of the movement from Nova Scotia is considerably greater than for the shipment from lake ports. In 1939, the total cost of vessel movement from Glace Bay to Montreal, including rail rate to port, dumping, wharfage and handling charges, amounted to $1.27. In the Fall of 1946, as this report is being written, the transportation cost for the same movement is $2.43 per ton. The full implications of this sharp increase in transportation costs are further discussed in the chapter on Markets.

COMPARISON OF LEVELS OF FREIGHT RATES

Because the freight rates applied by the railways are so important an element in the marketing of coal in Canada, it appears appropriate to examine the level of existing rates in relation to rates on other commodities in Canada, and also in comparison with rates on coal in the United States.

Coal Rates Compared with Other Commodities in Canada

Rates on coal in Canada, as in the United States, are among the lowest of those charged on any commodity. In the light of rate-making principles already described, it is obvious that this should be the case. Comparing coal rates with rates on other commodities, the following examples are representative of the situation, all rates being shown per net ton:

Sydney, N.S. to Bathurst, N.B.	Coal $2.00, cordwood $2.50, pig iron $2.95, lumber $3.60.
Maccan, N.S. to Moncton, N.B.	Coal 80 cents, cordwood $1.00, lumber $1.70.
Port Arthur, Ont. to Winnipeg, Man.	Coal $3.30, crude petroleum oil $4.60, cement $5.40, soda ash $7.20.
Drumheller, Alta. to Winnipeg, Man.	Coal $4.70, lumber $8.60.
Drumheller, Alta. to Port Arthur, Ont.	Coal $6.50, lumber $11.30.

Rates on coal from the Nova Scotia and New Brunswick fields are substantially lower than rates on fuel oil from Halifax, N.S., for comparable distances. The subvention rate of $8.00 per ton (of which the shipper pays only $5.50 per ton) on coal from Alberta mines to destinations in Ontario may be contrasted with rates of $15.60 per ton on eastbound lumber for similar distances, $11.00 per ton on crude or ground clay from Saskatchewan producing points to Eastern Canada and with rates applying in the reverse direction from Ontario to Alberta of $18.60 per ton on salt and $17.70 per ton on pig iron.

A particularly significant comparison is that between rates on coal and rates on grain. This comparison indicates that the rates on coal are lower than the grain rates throughout Canada, with the exception of certain statutory rates on grain determined by the Crowsnest Pass Agreement. Comparing first rates on coal in western Canada with grain rates not governed by the Crowsnest Pass Agreement, the following examples will illustrate the point, rates being shown per net ton. From Drumheller, Alta., to Prince Albert, Sask., the rate on coal is $3.20 and on grain $5.90; from Drumheller to Weyburn, Sask., $3.80 on coal and $6.40 on grain; from Lethbridge, Alta., to Prince Albert, $4.20 on coal and $7.30 on grain; and from Lethbridge to Lanigan, $3.80 on coal and $6.60 on grain.

The Crowsnest Pass Act, assented to by Parliament on June 29, 1897, confirmed an agreement between the Dominion Government and the Canadian Pacific Railway Company, whereby the Government granted aid to the railway for the construction of a line through the Crowsnest Pass in British Columbia, extending from Lethbridge to Nelson, in consideration of materially lower rates being given on grain and flour from the Prairie Provinces to Fort William and all points east, and on certain staple commodities from the east destined to points west of Fort William.

Except for some reduction made in grain rates in 1903, of which it is not necessary to give the details, the Agreement continued to determine grain rates until 1917 when it was suspended by Order in Council. However, in 1922, following a vigorous debate in the House of Commons, a statute was enacted restoring the Crowsnest Pass Agreement with respect to the eastbound movement of grain and flour, Parliament taking the view that in the interests of the Canadian economy the rates imposed by the Agreement upon the Canadian Pacific Railway should be restored and extended to all other railways in western Canada, with the result that the present rates on grain in this territory are on the same level as was made effective in 1898. To appreciate the extent to which this policy has affected grain rates to the Head-of-the-Lakes, we may make a comparison between such rates and the charges for comparable move-

ments in the United States. As an example, the grain rate from Calgary to Port Arthur is 26 cents per 100 pounds and from a point of equal distance in Montana to Duluth the rate is 55 cents per 100 pounds. Rates on coal from Alberta to Port Arthur and Fort William are somewhat higher than the grain rates, as shown below: from Drumheller, Alta., coal $6.50 and grain $5.20 per net ton; from Edmonton, Alta., coal $6.50 and grain $5.20 per net ton; from Lethbridge, Alta., coal $6.30 and grain $5.00 per net ton.

Coal Rates in Canada Compared with Coal Rates in the United States

When comparing levels of rates applying on coal in Canada with those applicable in the United States, one should try to compare like with like, so far as is possible. The comparisons should be for hauls of approximately equal length, rates applying in eastern Canada should be matched with those in the eastern United States, and similarly for the west. Nor should proportional rates be compared with rates covering the entire transportation service.

From what has been said earlier, it will be apparent that to find rates in the two countries covering railway services performed under identical circumstances is all but impossible. Generally speaking, coal rates in Canada are not higher than comparable rates in the United States and in some instances are actually lower. In the Eastern Rates case, the then Board of Railway Commissioners compared the rates established by the railways in Ontario with certain rates prescribed by the Interstate Commerce Commission for moving coal similar distances in the United States, and found that the Canadian rates were lower. Since that time, the rate increases permitted by the Board in Canada have been less than those allowed in the United States, with the result that the differences have been accentuated.

The Commission had compiled for it some comparisons of rates in Canada and the United States, which follow. It believes that due regard was paid to the need of selecting rates which were properly comparable.

FREIGHT RATES, PER NET TON, ON BITUMINOUS COAL, AS OF JUNE 30, 1946

—	Distance	Rate Paid by Shipper	Rate Received by Railway
		$	$
Sydney, N.S. to Truro, N.S.	226	1.50	1.88
Pocahontas District (Va.–W. Va.) to Lynchburg, Va.	199	2.15	2.15
Clearfield Dist., (Pa.) to Elmira, N.Y.	223	2.41	2.41
Sydney, N.S. to Moncton, N.B.	342	2.00	2.50
Clearfield Dist. (Pa.) to Syracuse, N.Y.	293	2.64	2.64
Clearfield Dist. (Pa.) to Oswego, N.Y.	350	2.76	2.76
Hardwood Ridge, N.B. to Edmundston, N.B.	166	1.10	1.38
Clearfield Dist. (Pa.) to Harrisburg, Pa.	154	2.18	2.18
Pittsburgh Dist. (Pa.) to Cleveland, O.	162	1.94	1.94
Maccan, N.S. to Drummondville, Que.	606	2.60	3.25
Clearfield Dist. (Pa.) to Standish, N. Y.	604	3.98	3.98
Stellarton, N.S. to Quebec, Que.	633	2.60	3.25
Clearfield Dist. (Pa.) to Boston, Mass. (Water Compet.)	627	3.87	3.87
Montreal, Que. to Ottawa, Ont. (Ex Water)	117	1.10	1.10
Conway, Pa. to Cleveland, O. (Ex Water)	115	1.55	1.55
Portland, Me. to Groveton, N.H. (Ex Water)	122	1.45	1.45
Detroit, Mich. to Toronto, Ont.	227	1.40	1.40
Ohio No. 8 District to Toledo, Ohio	213	1.99	1.99
Reynoldsville Dist. (Pa.) to Buffalo, N.Y.	200	2.19	2.19

FREIGHT RATES, PER NET TON, ON BITUMINOUS COAL, AS OF JUNE 30, 1946—*concluded*

—	Distance	Rate Paid by Shipper	Rate Received by Railway
		$	$
Estevan, Sask. to Winnipeg, Man	291	2.30	2.30
Republic, N.D. to Fargo, N.D	279	1.99	1.99
Roundup, Mont. to Marmarth, N.D	270	3.09	3.09
Truax, N.D. to Barnesville, Minn	296	2.35	2.35
Lethbridge, Alta. to Regina, Sask	401	3.10	3.10
Kirby, Wyo. to Helena, Montana	391	3.23	3.23
Pittsburgh, Kan. to Superior, Neb	390	3.00	3.00
Lethbridge, Alta. to Saskatoon, Sask	573	4.00	4.00
Roundup, Montana to Aberdeen, S.D	569	4.11	4.11
Sheridan, Wyo. to Bismarck, N.D	566	4.41	4.41
Drumheller, Alta. to Brandon, Man	657	4.40	4.40
Southern Illinois Dist. to Hutchinson, Kan	652	5.60	5.60
Walsenburg, Colo. to Omaha, Neb	665	5.15	5.15
Drumheller, Alta. to Winnipeg, Man	783	4.70	4.70
Somerset, Colo. to Hastings, Neb	754	4.90	4.90
Walsenburg, Colo. to Sioux City, Ia	786	5.40	5.40
Coalspur, Alta. to Vancouver, B.C. (Compet.)	663	3.90	3.90
Roundup, Montana to Coeur d'Alene, Idaho	633	4.13	4.13
Bear Creek, Mont. to Spokane, Wash	649	4.13	4.13

(N.B.—Applications for permanent increases in rates were pending before the regulatory Commissions of both Canada and the United States in October, 1946.)

In the absence of actual rates applied in the United States for movements comparable with that from Alberta to Ontario, only a rough comparison may be made between rates per ton-mile and per car-mile in the case of the Alberta movement and some low rates published in the United States. The distance from Drumheller to Toronto is 1,990 miles, and coal from this field is ordinarily shipped in box cars containing about 40 tons. The normal rate of $12.70 per ton is equivalent to 6.4 mills per ton-mile and 25.6 cents per car-mile; the subvention rate of $8.00 per ton is equal to 4.0 mills per ton-mile or 16.0 cents per car-mile. In the United States, the rates from Illinois mines to Chicago are highly competitive. Several million tons of coal move annually from the southern Illinois district to the Chicago area, an average distance of 358 miles in open top cars averaging about 55 tons per car. The rate for this movement, $2.05 per ton, was prescribed by the I.C.C. as a minimum rate, and is equal to 5.7 mills per ton-mile or 31.4 cents per car-mile.

The very heavy movement of coal to the Lake Erie ports for trans-shipment has already been mentioned in this chapter. The tonnage handled in 1945 was over 50,000,000 tons and the average load per car was about 60 tons. The movement is largely in trainloads. There are great quantities of iron ore shipped inland from the lake ports which provide return loads for many of the cars used to handle coal to the lake ports and the service is performed during the summer when operating conditions are most favourable. The rates applied on this movement are proportionals covering part of a through movement, and are affected

by competitive influences. The level of rates varies, but the following will illustrate the general range:

From	To Lake Erie Ports, Lake-Cargo			
	Average Distance	Rate per Net Ton	Rate per Ton-Mile	Rate per Car-Mile
		$	Mills	Cents
Pittsburgh District, Pa	172	1.56	9.1	54.6
Fairmont District, W. Va	269	1.76	6.5	39.0
Kanawha District, W. Va	370	1.91	5.2	31.2
Pocahontas District, Va., W. Va	436	2.06	4.7	28.2

The examples cited in this section are an indication that the level of freight rates on coal in Canada is not dissimilar to that in the United States. We wish to emphasize again, however, that a strict comparison cannot be made, for conditions in the two countries differ considerably; this is particularly true of the movement of western coals into the Provinces of Ontario and Quebec.

TEST MOVEMENTS, COST DETERMINATIONS AND TRAINLOAD RATES

The Dominion Government's assistance to Canadian coal producers in their attempt to secure a larger share of the markets in Ontario and Quebec has been linked with efforts to determine the cost of transporting coal by rail from Alberta to Ontario and from the Maritimes to Ontario and Quebec. While the cost determinations in the case of the movement from the Maritimes were undertaken somewhat later than the Alberta tests, they have been much less extensive and significant and we can, therefore, deal with them before proceeding to a discussion of the test movements of western coal.

Test Movements in Eastern Canada

With a view to expanding the markets for Nova Scotia and New Brunswick coal, the then Board of Railway Commissioners was directed by Order in Council P.C. 226 dated February 13, 1926, to ascertain the rail cost of transporting coal mined in eastern Canada to consuming points in Quebec and Ontario during closed navigation on the St. Lawrence River. Supplementing this direction, Order in Council P.C. 539 of March 30, 1928, was issued, requiring the railways to publish a nominal rate of $3.00 per ton on all-rail shipments of coal from Nova Scotia and $2.10 per ton on coal from New Brunswick to points in the Province of Quebec for a three-year test period, and the Board of Railway Commissioners was authorized to enquire into the cost of the movement to determine a rate per ton and also the payments which might be due the railways above the nominal rate. In its report to the Government dated February 13, 1931, the Board found that the additional cost, including the factor of operating profit, for the all-rail movement from Nova Scotia was $1.95 per ton in excess of the nominal rate, or a total of $4.95 per ton. From Minto, N.B., the difference over the nominal rate was $1.36 per ton, or a total of $3.46 per ton. Further tests conducted during the winter seasons of 1929-30 and 1930-31 in the transportation of coal from the Maritimes to the Province of Quebec led to the conclusion that the costs did not vary from the figures above mentioned.

Test Movements, Alberta to Ontario

For many years the question of freight rates on coal from Alberta to Ontario has been the subject of extended consideration and investigation by the railways, the Board of Railway Commissioners for Canada, the Dominion Govern-

ment, and the Provincial Governments of Alberta and Ontario. The consideration of the rates falls into three periods, i.e., from 1923 to 1926 when the Canadian National Railways made its own experiments in moving coal from Alberta to Ontario, from 1926 to 1933 when the Dominion Government directed that further test movements be made to establish the cost of transportation of the coal, and the period since 1933 with the adoption of a policy of transportation subventions.

Following the anthracite strike in the United States in 1922 and the consolidation of the Canadian National Railways and the Grand Trunk Railway System in the early part of 1923, interest in the possibility of moving Alberta coal to Ontario grew, and from July 1923 to the early part of 1926 the Canadian National Railways instituted special rates at various times of \$7.00 and \$9.00 per ton. Five experimental lots of coal (consisting of 1,250 tons, 4,961 tons, 10,000 tons, 25,000 tons, and 50,000 tons) were shipped during this period. The traffic was carried as an experiment by the Canadian National Railways without subvention in an effort to ascertain whether a substantial movement could be developed at a low rate basis in competition with United States anthracite.

These experiments of the Canadian National Railways did not, however, produce the results expected, and the Dominion Government issued Order in Council P.C. 225 on February 13, 1926, which in part set forth:

> "That on account of the distance to be traversed in the coal mining areas of Western Canada and the large consuming areas in Ontario, the element of the cost of transportation of coal mined in Western Canada is of paramount importance, and, there appearing good reason to believe the cost of the same would be very considerably reduced if this movement takes place at a time when the rolling stock of the railways is not mobilized for the transportation of the grain crop of Western Canada, therefore, the Board of Railway Commissioners for Canada be requested to enquire and report to the Government upon the question of the cost of transportation of coal per ton in full capacity trainload quantities for such seasonal movements, such enquiry and report to show as nearly as practicable what rate or rates per ton would be the actual cost of the movement, both exclusive and inclusive of overhead, superintendence, and allowance for operative profit; (*a*) from an operating standpoint and eliminating the costs which would have to be incurred in any event, (*b*) inclusive of the same."

Following this direction, the Board instituted an enquiry and required the railways to submit extensive data, which the Board analysed with the assistance of cost experts of the railways and a cost expert for the Provincial Governments of Alberta and Ontario. In order to provide additional specific information on which to base costs, Order in Council P.C. 1446 of September 24, 1926, was issued. The Order in Council in part set forth that:

> "It was expedient in the public interest that measures should be taken to obtain the cost per ton of moving coal by rail in solid trainloads from the coalfields in the Province of Alberta to the Province of Ontario, it being stated that no solid train of coal had been moved by rail from Alberta to Ontario and therefore no complete cost records were available; and that arrangements had been made with the Canadian National Railways to transport a solid train of cars from Drumheller to Toronto and that suitable records were to be made of the movement of the train;
>
> The railway company would charge a rate of \$9.00 per ton, of which the Dominion Government would pay \$2.00 per ton;
>
> The coal would be consigned to the Fuel Controller of Ontario and sold by him."

After an experimental shipment was made, the enquiry instituted by the Board under direction of Order in Council P.C. 225 was continued. The findings of the Board in this connection and the dissenting opinion of Commissioner

Oliver are published in Volume XVII of the Board's judgments, pages 439-467, of September 22, 1927. While Order in Council 225 directed that the cost of transportation of coal per ton "in full capacity trainload quantities" be investigated, it became evident in the early part of the investigation that such "solid-train" loads were impracticable. The Board commented upon that fact at page 442 of its judgment.

In the report with respect to P.C. 225, the Board set out its understanding of the direction in that Order as follows:

"In summary, what is asked for, as we understand it, is:

(1) The out-of-pocket cost,

(2) The out-of-pocket cost plus the coal traffic's share of the cost incurred in any event, the latter cost being diluted by the added ton mileage resulting from the coal movement, and

(3) Also item (2) plus the element of profit".

The necessity for such information in relation to the coal movement was unique in railway experience, and it is apparent that a sincere effort was made to develop the data on which conclusions could be based. The Board summarized its findings as follows:

	Per Ton
(1) Out-of-pocket cost	$ 7.22
(2) "Inclusive" cost	10.07
(3) "Inclusive" cost, plus the element of profit	12.20

On the basis of these findings that as of the year 1927, the bare out-of-pocket cost for transporting Alberta coal to Ontario for an average distance of approximately 2,000 miles was 3.6 mills per ton-mile; inclusive cost of operation was 5 mills per ton mile; and the inclusive cost plus profit 6.1 mills per ton mile. Commissioner Oliver, in his separate judgment, arrived at an out-of-pocket cost of $6.50 per ton after eliminating certain elements of cost which he thought were inapplicable, and refrained from making any findings as to inclusive cost, and inclusive cost plus profit.

Following this exhaustive enquiry, the Dominion Government, by Order in Council P.C. 439 of March 16, 1928, required the railways to institute test movements of Alberta coal for a period of three years and to publish a nominal rate of $6.75 per ton. The Order further directed that the Board of Railway Commissioners make continuing studies during this period of the cost of moving Alberta coal to Ontario, and the difference between such cost and the nominal rate of $6.75 per ton was directed to be paid out of the Dominion Treasury. In accordance with this direction the Board required the railways to submit the costs of movement of the coal actually transported under the nominal rate of $6.75 per ton for each year and detailed cost studies were submitted to the Board. After carefully reviewing these cost studies the Board found that the cost was $8.23 per ton.

The Board was then directed by Order in Council P.C. 1179 of May 18, 1932, to ascertain what may be described as the bare out-of-pocket costs, and this was done for the year 1931. After investigation, the Board reported on February 1, 1933, that the bare out-of-pocket cost from Drumheller to North Bay was $6.06 per ton, and to Toronto $6.88 per ton, but it qualified its findings by this statement:

"The railroad adopted a program of retrenchments, extraordinary economies and deferred maintenance resulting in a substantial decrease in operating expenses. These out-of-pocket costs reflect subnormal conditions in operations and should not be considered as applicable to any period other than the year ended December 31, 1931."

During all these investigations the railways contended that their published rates were reasonable, and this contention seems to be supported by a report by the Board to the Dominion Government dated March 16, 1933, wherein it was stated:

> "The only rates under review in the present case are those applicable to the coal movement.
>
> We have determined that the tariff rates are only slightly in excess of the operating expense cost of transporting the coal.
>
> Giving consideration to the relation of coal rates to rates on other commodities and without disturbing the parity but keeping in mind the factors which in the national interest may properly be taken into consideration, it is our judgment the reasonable rates on coal from Alberta points to points in Ontario are the rates published in Canadian National Railways Tariff C.R.C. No. W 354 and Canadian Pacific Railway Company Tariff C.R.C. No. W 2727."

Following this conclusion the Dominion Government, in respect of test movements directed, paid the difference between the rate of $6.75 and the normal tariff rates. It was obvious, however, that coal would not move from Alberta to Ontario on published rates. It then became a question as to what could be done to develop the movement. Consideration resulted in an offer by the railways to carry the coal at a rate of $8.00 per net ton provided the Dominion Government would contribute $2.50 per ton to reduce the cost to the shipper to $5.50, and this rate was established.

Trainload Rate Proposal

It was suggested to the Commission that by moving coal in solid trains the cost could be so reduced that a rate of $5.00 per ton could be maintained by the railways and that such a rate would earn a profit for the carriers. The proposal contemplates the accumulation of trainlots of 50 cars of 40 tons each at any of five assembling points in Alberta, moving them in unbroken trains to Orillia, Ontario, and distributing the cars individually from that point, the $5.00 rate to include delivery to all stations within 100 miles of Orillia, and be subject to additional charges of 0.5 cent per ton for each additional mile of haul outside the 100-mile radius.

At two sittings of the Commission there was considerable reference to trainload rates in the United States, and it is therefore desirable to treat briefly with two existing trainload rates in that country, which were cited to us in support of a trainlot rate to Ontario. One of these, a rate of $2.00 per ton on coal in lots of 2,000 tons from mines in Arkansas and Oklahoma to St. Louis, Mo., compared with a rate of $2.75 per ton in single-car lots. This rate was published only by the St.Louis-San Francisco Railroad, and applies only to dealers served by that line. Where delivery is taken on the lines of other railroads in the St. Louis area, there are additional switching charges ranging from 20 cents to 70 cents per ton, whereas these switching charges are included in the $2.75 rate applicable on single-car lots.

Another example cited was a rate of 15 cents per 100 pounds for the movement of molasses from New Orleans, Louisiana to Peoria, Illinois, in lots of 38 cars, compared with a rate of 17.5 cents when in single-car lots. An examination of the report (235 ICC 485) of the Interstate Commerce Commission approving this rate indicates that the circumstances under which it applies are special and unusual in a number of respects. The rate was established to meet barge competition, no competing shippers were involved, the minimum quantity of 38 carloads was to be available for shipment on a single day, and the 38-car block could be included in a train hauling as many as 71 cars.

Bearing in mind that a movement in solid trains of 50 cars from Alberta to Ontario is not physically possible even during the summer months over the railways involved and that the accumulation of the required minimum tonnage and the departure from the practice of handling full tonnage trains up to the maximum capacity of each railway subdivision might entail additional expense as compared with existing practices, the trainload rate proposal offers small hope of reducing the cost of transporting Alberta coal to Ontario. The movement of grain from the western provinces to the Head-of-the-Lakes is in trainload quantities. As we have seen, the rates for this movement are controlled by the Crowsnest Pass Agreement and are now on the same level as in 1898. With a rate of $5.20 per ton applying on grain from Drumheller to Port Arthur, the proposition that the railways could transport coal from Drumheller (an additional 700 miles or more) to reach the markets of Central Ontario at a rate of $5.00 does not appear to be a reasonable one.

SPECIFIC TRANSPORTATION PROBLEMS

Railway Rates from New Brunswick Mines

The New Brunswick Coal Producers' Association, representing seven coal producers whose output constitutes over 90 per cent of the Province's production, submitted a brief to the Commission which dealt in part with the railway rates applying from the mines in the Minto-Chipman field to various destinations, principally in New Brunswick. The brief calls attention to—(1) charges assessed for moving coal from the collieries over spur tracks to the main lines of the railways, (2) inequalities in these charges as between different mines, and (3) differences in rates from New Brunswick mines as compared with rates from Nova Scotia mines to certain destinations.

Insofar as this rate adjustment may constitute unreasonable and unduly prejudicial treatment of certain operators in the Minto field as compared with other operators in the district, or as compared with Nova Scotia producers, it appears that these are matters which should be presented to the railways and if necessary to the Board of Transport Commissioners. The Producers' Association does not, however, suggest that the freight rate structure be changed, but rather that the inequalities be eliminated by the payment of subventions. The same proposal has been made on previous occasions to the Dominion Government. There are a great many differences in freight rates as between coal producers in various parts of Canada, and for the Government to undertake by subvention payments to counterbalance all such differences would involve many difficulties. It is the view of this Commission that a recommendation of subvention payments for this purpose is not warranted and that the producers, if they feel that the present situation is a hardship on them, should pursue the matter further with the railways and the Board.

Alberta Coal Via Rail-and-Lake to Great Lakes Ports

The suggestion has been made that the marketing of Alberta coals in eastern Canada might be expanded if they were moved by rail to Port Arthur or Fort William and down the lakes by boat to ports on the lakes, more specifically to Georgian Bay ports. While attractive in theory, the proposed transportation does not appear to be either practical or economical. The physical structure of most western "domestic" coals is such that degradation resulting from the handling from cars to vessels and vessels to docks, and from storage on the docks, would create serious marketing problems. The present facilities at Port Arthur and Fort William are not well adapted to a transfer of coal from rail to water-carriers. A movement of coal down the lakes would have to compete with the other commodities for vessel space, and it could not be expected that the rates offered

would be on anything like the same low level as for movement of coal to the Head-of-the-Lakes. The rate on coal from Drumheller, Alberta to Port Arthur and Fort William is $6.50 per ton. Adding to this the cost of transfer to vessels and a vessel rate to Georgian Bay or lower lake ports, it is clear that such a movement could not compete with the all-rail transportation for which the present charge is $8.00 per ton.

The Canso Causeway

Cape Breton Island is separated from the mainland of Nova Scotia by the Strait of Canso, a body of water about 16 miles long and 4,000 feet wide, with depths ranging from 100 to 160 feet. Transportation across the strait is provided principally by two car ferries operating between Mulgrave on the mainland and Point Tupper on the island, and carrying both freight and passenger cars. The railway lines from Sydney to Point Tupper, Mulgrave to Stellarton, and Truro to Moncton, N.B., have heavy grades and curvatures which limit the load that locomotives can handle over these sections. It has been proposed that the ferries over the strait be replaced by a causeway or a bridge, and that the three sections of railway line be re-aligned or rebuilt.

There is no doubt about the desirability of these changes from the standpoint of general convenience but we have given consideration only to the effect of the present arrangements on the transportation of coal, and what results could be expected from construction of a causeway and revision of the railway line. The large proportion of the output of coal on Cape Breton which is consumed by steel plants on the island or shipped by water from Sydney in normal times has already been noted. The physical limitations of the existing rail route have not apparently restricted the distribution of Cape Breton coal to market by railway. During the war, because of the shortage of vessels there were heavier shipments of coal by rail across the strait which coupled with heavy wartime movements of other commodities resulted occasionally in congestion and delay to shipments. The increase in vessel capacity now taking place will apparently reduce the movement of coal across the strait to approximately its pre-war volume, so that from the standpoint of transportation capacity of existing facilities, it cannot be seen that the marketing of coal would be materially assisted by the proposed construction.

It was suggested to the Commission that the proposed causeway and revision of line would so reduce the cost of railway operation as to warrant substantial reduction in freight rates from the mines and expand shipments by rail to markets in Quebec and Ontario during the winter months—for example, a reduction of $1.23 per ton in rates to Montreal was proposed. The construction would make comparatively small reductions in the length of the rail hauls. In this connection it might be pointed out that the present rail rates paid by the shippers to Montreal are $3.80 per ton from Sydney and $3.30 per ton from Stellarton on the mainland, a difference of only 50 cents per ton. Even with the proposed construction, the distance from Sydney would still be more than 125 miles greater than from Stellarton, so that the expectation of any such substantial reduction in rates is illusory. Further, the difference between the water cost and even greatly reduced rail rates is so large that there is no reason to expect a diversion of traffic to the railway route if the rates from Stellarton to Montreal should be extended to apply from Sydney.

The St. Lawrence Deep Waterways

The Great Lakes and the St. Lawrence River have provided an artery of transportation for many years, the canals at Sault Ste. Marie and Welland making the lakes navigable by large steamships from the Head-of-the-Lakes to

Lake Ontario. On the St. Lawrence River the Lachine Canal, built many years ago, makes navigation between the Great Lakes and Montreal possible for small sized boats, generally termed canalers.

About 1905 the deepening of the St. Lawrence River to accommodate ships of much deeper draft was first projected and, following much examination in the intervening years, resulted in 1932 in the signing of the St. Lawrence Deep Waterways Treaty between the Governments of Canada and the United States, which provided for a channel of 27 feet. However, all treaties are required to be ratified by a two-thirds majority of the Senate of the United States, and the project collapsed when the Treaty failed to secure the necessary majority in the United States Senate. In March of 1941, a new agreement entitled "The Great Lakes-St. Lawrence Basin Development", which also calls for a 27-foot channel, was concluded between the two countries. This agreement has since been under consideration by the Senate of the United States but has not yet been ratified by that body.

Over the years, the project has become as important from its hydro-electric aspects as from the deep-sea waterways standpoint. Both countries, under the agreement, would share in the power generated. The development of the International Rapids section proposes two powerhouses, one on the Canadian side and the other on the United States side, each powerhouse to have an installed capacity of 1,100,000 horsepower. The total cost of the whole project has been variously estimated, but as Canada has already contributed to the project by the construction of the Welland Canal, which merely has to be deepened, her additional contribution will not be as large as that of the United States.

The project has been generally, although not unanimously, regarded with approval in Canada; but in the United States amongst the interests opposing it are the coal mining industry, the railways and shipping companies, the organizations of labour employed in such industries, and certain communities which feel they may be adversely affected.

Assuming, however, that the project is eventually proceeded with, this is an appropriate place for some speculation as to its effects on the Canadian economy, with particular reference to coal. The waterpower development will result in further large supplies of power, which will have the effect of displacing some coal as a source of energy. At the same time it will make for an intensely industrial area in the St. Lawrence basin and, to that extent, coal may derive some benefit. With the completion of the project, many seagoing boats would be able to proceed to upper lake ports without trans-shipping cargo, and as a sizeable amount of coal was imported prior to World War II to the ports on the St. Lawrence River from Great Britain and Europe, including Russia, resumption of that movement may be possible and the canal would permit a further extension to ports on the lakes. At the present time most Nova Scotia coal waterborne to Montreal has to be trans-shipped, either by rail or by smaller sized ships, for westward furtherance. The development of the waterways would make it physically possible for much larger boats to move directly from Sydney to any port on the Great Lakes. On the other hand, there is also the strong probability that United States coal, which now moves in some volume down the St. Lawrence in canalers, would move through the enlarged canal in the more economical bulk steamers and be more competitive in the Montreal area that at the present time. Furthermore, the waterways would probably encourage the inflow to Canadian points of foreign petroleum and fuel oil, thereby increasing the competition with

coal. The canal would not, of course, be a year-round operation, since ice will prevent navigation during the winter months; therefore the project offers no solution to Nova Scotia's problem of seasonal coal movement.

CONCLUSIONS

The foregoing review of transportation of coal in Canada makes it evident that the distribution is not handicapped by any lack of adequate facilities for movement by rail or water or for the physical transfer of coal from one means of transportation to another. Even with the necessity of concentrating the vessel movement into the months of open navigation on the rivers and lakes, the capacity and co-ordination of the transport facilities is such that in normal years inadequacies of transportation are virtually unknown. During the war there was, of course, an interruption in the vessel movements up the St. Lawrence River, and this situation is not yet fully corrected.

The review of freight rates indicates that in relationship to other commodities the rates maintained on coal are among the lowest, and that railway rates on coal in Canada are generally comparable to those in the United States.

Nova Scotia coals, because of relatively high production costs, must rely on water transportation to reach markets outside the Maritimes, and before the war only the low cost of transporting coal by vessel enabled Cape Breton coal to compete with imported coals as far west as Montreal. Beyond Montreal, subventions were required to permit the marketing of Maritime coals in the face of competition from United States sources. The marked increase that has occurred since 1939 in vessel rates raises doubt as to the ability of Nova Scotia coal to maintain its competitive position.

Broadly speaking, western "steam" and "domestic" coal is competitive with imported coal under existing railway rates about as far east as Winnipeg. The principal market for the "steam" coals is for railway use, and for this purpose the published freight rates are not a factor. In the case of the "domestic" coals it seems clear that it is not possible to have unassisted rates low enough to permit movement of this coal to the densely populated areas of Ontario so that if "domestic" coals are to be marketed in this area there must be assistance through subventions. This is also true of marketing western coals for industrial use east of Winnipeg.

CHAPTER VII

DISTRIBUTION

The price of coal to the consumer is the mine cost, plus duty in the case of imported coal, plus transportation and plus the cost of services provided by the distributive trade. Excessive costs in any of these fields must work to the disadvantage of either the producer or the consumer, or both. Production and transportation costs have been discussed in other chapters, and this chapter will only examine the services provided by the distributor and the price he charges for those services.

The chapter on Markets gives full information as to the types of coal used in the various areas, where it originates, and the approximate tonnages. The Maritimes use principally Maritime coal, Western Canada uses coal produced in that area, and Central Canada uses chiefly imported coal. Prior to the war substantial quantities of United States and United Kingdom coal were used for domestic heating in the Montreal and Lower St. Lawrence regions, and Maritime coal was an important fuel for industrial and railway purposes in Central Canada east of Lake Ontario. The entire Central Canada area is now, however, almost entirely dependent on United States coal for all purposes.

The terms used in describing those engaged in the distribution of coal are importer, wholesaler and retailer. Wholesalers are those engaged in buying and selling coal, the sales being generally to the retail trade or to large consumers. They may physically handle some coal, although in most cases coal sold by them is shipped direct from the mine to the customer without going through the wholesaler's hands; and some wholesalers never actually take possession of any coal. Retailers are those who take delivery of coal and sell it to the ultimate consumer. In areas where water-borne coal is imported, the importation is usually handled by a wholesaler who takes delivery of coal in large quantities and maintains coal stocks on hand. In such cases he is commonly termed an importer. Where most of the coal used is shipped by rail and possession is not taken by the wholesaler, the term importer is not often used, although the coal originates in a foreign country. It is not possible, however, to adhere strictly to any classification when dealing with the subject of distribution. Frequently a retailer imports his own coal and may act as a wholesaler with respect to some isolated transactions; in some cases a distributing concern owns the mines which are its principal source of supply; and sometimes the producer operates his own selling agency, occasionally to the extent of handling his own retail sales.

As by far the greater part of Canada's coal consumption occurs in the Provinces of Ontario and Quebec, herein designated as Central Canada, it is proposed to deal with that area first, turning then to the Maritimes and to the West.

CENTRAL CANADA

Mechanics of Coal Importation

United States coal enters Central Canada both by rail and by water. The rail movement of coal requires no special comment. The coal is loaded on cars at the mine and is routed, as a rule, direct to the premises of the larger consumer or to the distributing yard of the retail dealer, at which point it is unloaded and trucked to the consumer's premises after being screened, oil treated and bagged, if such services are necessary for the purposes of the particular consumer.

Due to the proximity of Central Canada to the anthracite fields of Pennsylvania, and the fact that it is a domestic fuel conveniently handled in carload lots direct to the retailer's yard, most of the anthracite consumed in Central Canada is still brought in by rail, although a considerable tonnage also moves by water.

In recent years bituminous coal has been principally water-borne. The present water movement of coal, at least to the areas of greatest industrial activity on Lake Ontario, is a comparatively new development. While there has been considerable movement of coal on the Great Lakes for about a century, the opening of the Welland Ship Canal in 1931 permitted the passage of large-sized ships from Lake Erie to Lake Ontario and accelerated the development of large self-unloading vessels which could discharge their cargoes at any point having sufficient depth of water to accommodate them. While this did not greatly affect the importation of coal into the Upper Great Lakes region, where bulk freighters are still used extensively and many docks have facilities for unloading them efficiently, and did not influence to any great extent the movement of American coal from United States ports on Lake Ontario into the area east of Cornwall where small canalers are still required, it did lead to a great expansion in the water movement of United States coal to such large centres of industry and population as Toronto, Hamilton and the Niagara peninsula, and by shortening the expensive rail haul to the trans-shipment point brought about a shift from some of the sources of supply in Pennsylvania to southern coal fields.

Efficient discharge of coal delivered in bulk freighters requires the use of either a coal bridge, which moves coal directly from the boat into storage, or coal towers, which unload coal from vessels into small cars holding from five to twenty tons which are moved on elevated tracks to the storage area where the coal is dropped. The development of the self-unloading collier, discharging its cargo at rates in excess of 1,000 tons an hour, made it possible to deliver cargoes economically at many ports where tonnage would not justify the heavy expense of installing unloading equipment. The development of shallow-draft small self-unloaders of approximately 1,000-ton capacity led to the establishment of many small docks to look after local consumption at lower cost. The opening of the Welland Canal and the development of the self-unloader altered the mechanics of coal importation from Quebec City to the Head-of-the-Lakes. In this section there are, in all, over sixty points where United States water-borne coal is unloaded. These points, with the type of vessel handled, the principal method of trans-shipment and the approximate tonnages received are shown in Appendix B of this report.

Coal docks vary considerably in the type of equipment used. Docks on the Upper Lakes or the Lower St. Lawrence, such as those at Fort William or Quebec, accustomed to receiving coal by bulk freighter, still use the towers or coal bridge for unloading; docks built for the use of large self-unloaders and handling considerable tonnages do not have the towers or bridge but have elaborate facilities for moving, screening and treating coal; and small docks served by the smaller self-unloaders may have as little equipment as one or two small portable conveyers.

The docks at Toronto are a good example of the recent development of the dock business, as a comparitively small amount of United States coal came into that city by water prior to the opening of the Welland Canal. There are sixteen dock operations in Toronto, handling a total of some 1.5 to 2 million tons a year. These vary in size from smaller docks handling as little as 50,000 tons to larger ones handling approximately 300,000 tons. They are all designed to receive coal by self-unloading vessel. The dock area in this city practically

all belongs to the Harbour Commission, which has reclaimed the land and built the dock frontage, and leases dock areas to coal importers or private dock operators. There is sufficient depth of water to accommodate any vessel. The dock areas run as much as 800 feet in depth from the waterfront, and as the coal is deposited by the self-unloader vessels at approximately 200 feet from the water most of the coal must be moved to storage areas at the rear. Some of the docks have installed belt conveyers equipped with stackers to move this coal into piles or storage hoppers, but most of the docks move the coal back either by casting with cranes or by trucking and ramping.

From storage the coal is reloaded into trucks for delivery to the retailer or consumer, either directly by cranes or a portable conveyer, or is handled by these means through hoppers having a capacity of forty to fifty tons each. Most of the domestic coal is handled through the hoppers, which are generally equipped with screens, with apparatus for oil treatment, and with bagging platforms. At a point like Toronto, most water-borne coal for domestic consumption is trucked direct from the docks to the householder.

The docks are also equipped with railway facilities which can be used for both incoming and outgoing shipments, although in the case of Toronto they are used almost entirely for incoming coal, as practically all deliveries to retailers and consumers are made by truck. Railway cars on these docks are generally unloaded by crawler cranes with clam-shell buckets, although sometimes railway cars are dumped into shallow underground pockets from which the coal is brought to the surface by a conveyer belt system or portable conveyer.

In order to supply the varied consumer requirements, many different kinds and sizes of coal are handled on the dock. Typical of these are northern coals from Pennsylvania and Ohio in egg, nut, stoker and nut slack sizes; West Virginia and Kentucky high volatile coals in the same sizes; Pocahontas coal from southern West Virginia in stove, nut, pea and stoker sizes, and, in addition to these bituminous coals, three or four sizes of anthracite and two or three sizes of coke.

The docks handling considerable tonnages of domestic coals are equipped with machinery for treating the coal with oil, this applying particularly to stoker coals, which although often so treated at the mine have to be treated again at the dock to ensure dustless delivery. Practically all coals, except industrial and stoker sizes, are re-screened, and the resultant screenings constitute a considerable operating problem. An example of this is Pocahontas stove size where, the coal being very friable, only about 65 per cent is recovered for sale as domestic coal, the remaining 35 per cent being sold as screenings for industrial and commercial uses.

While the Toronto docks have been dealt with as representing the new development in coal handling resulting from the use of the self-unloader, dock operations on the St. Lawrence, such as those at Quebec, Three Rivers and Montreal, are equally efficient, differing principally in that most of the coal arrives in bulk freighter and requires unloading equipment.

These docks are usually operated by persons or firms engaged in the wholesale distribution of coal, although in some cases dock operations are carried on as an independent business by persons who are not themselves engaged in the buying or selling of coal, and in others by persons engaged principally in the retail trade.

Having dealt in brief with the mechanics of the importation of coal, it is now proposed to deal with the individuals who engage in this trade and who deal with the coal following its importation.

Wholesale Distribution

United States Bituminous

United States bituminous coal, in normal times principally water-borne, is handled largely by a relatively small group of companies. This is natural having regard to the cost of equipping a modern dock, which might run to upwards of one-half million dollars, and to the capital required to meet operating expenses and maintain large stocks of coal on hand for considerable periods. A number of the larger producers of this coal in the United States have established importing and wholesale subsidiaries in Canada, and in other cases have given exclusive contracts for the Canadian distribution of their coal to a single Canadian company.

In addition to operating their own docks, coal importers place substantial tonnages of coal on docks owned by others. In such cases they may pay a dock-handling charge of so much per ton to the dock operator, the charge varying depending on the way the coal is handled, the tonnage involved, and the amount of treatment required to be given the coal on the dock. In some cases the dock is operated by the railway company and the charge is absorbed in the outgoing freight from the dock. In other cases the dock company may own, in addition to the dock, the vessels bringing coal in from the United States exporting port, and the boat and dock charges are combined in one handling charge. Frequently coal is sold direct to a dock company which re-sells to the trade. In the case of railway coal, the contract may merely oblige the importer to deliver a specified amount of coal at an f.o.b. mine price and ship it to a United States lake port, after which full responsibility in connection with the payment of freight, the dumping charges, and the delivery, is that of the railway. In some instances the purchaser may provide a ship but desire to have it loaded, in which case the importer will ship the coal to the United States lake port and pay the railway freight and dumping charges, which will in turn be billed to the customer. In other cases the vessel will be arranged for and the duty will be paid by the importer.

The importer, if a wholesaler, usually makes direct or off-dock shipments in the case of bituminous coal to large consumers and to retailers, and does not seek direct sales to small consumers because the credit risk of the customers and a variety of other circumstances make it easier for the individual dealer rather than the wholesale firm to satisfy the ultimate consumer; although at points where the wholesaler maintains a dock, he will often sell to smaller industrial or commercial consumers in the immediate locality, the coal being delivered direct from the dock to the consumer in dump trucks. Some wholesalers sell even to householders, and some retailers, even those without dock facilities, have large industrial accounts. It is estimated, however, that in general the dividing line is in the neighbourhood of 200 tons annual consumption, those consuming more than that amount purchasing from wholesalers, and retailers supplying consumers with smaller annual requirements.

The importer-wholesaler is obliged to maintain close contact with the United States producing fields, to enable him to locate and supply the coal most adaptable to the consumer's needs. He must also promote the use of coal produced by the United States supplier with whom he has a contract and try to persuade the consumer to use burning equipment suited to the coal which he supplies. He often employs a combustion engineer to advise customers and potential customers. He supervises the movement of coal from the mines to the lake front, and the co-ordination of the rail movement to the United States loading dock with the lake vessel movement to the Canadian destination. Careful planning is required to accomplish this. Some coals break down in storage more than others and must be shipped as late as possible in the navigation

season. He must find market outlets to prevent an unbalanced position at the mines between sizes. He must make all the necessary arrangements for the handling of the coal once it arrives, and he must so correlate supplies and requirements to prevent over-stocking and yet have available sufficient coal to satisfy his customers.

The handling of United States bituminous coal, due to the great number of American suppliers and the wide variety of coals, does not follow any set pattern, and it is comparatively easy for any distributor to make his own arrangements to secure a supply of this fuel. It is handled in Central Canada principally by the following companies, each of whose annual tonnage of coal handled both as importer and as broker is in the neighbourhood of one million tons or more: Canada Coal Limited, Empire Hanna Coal Company Limited, Pittsburgh Coal Company Limited, Rochester and Pittsburgh Coal Company (Canada) Limited, Valley Camp Coal Company of Canada Limited, (all of which are subsidiaries of or affiliated with United States producers), and Boon-Strachan Coal Company Limited, Canadian Import Company Limited, Mongeau and Robert Compagnie Limitée, and F. P. Weaver Coal Company Limited, which are amongst the largest of the Canadian-owned companies.

United States Anthracite

United States anthracite, being generally rail-shipped, does not involve quite the same complications as is the case with bituminous coal. Some of it is handled over the docks, but as a general rule it is shipped direct to the yard of the retailer. Most of it originates in the mines of the "line companies", which are comparatively few in number and are the principal suppliers to the Canadian market. Some of these companies have incorporated marketing subsidiaries in Canada and in other cases grant exclusive agency agreements either for all Canada or for a particular area.

The principal American suppliers to the Canadian market are the Delaware Lackawanna and Western Coal Company, Philadelphia and Reading Coal and Iron Company, Jeddo-Highland Coal Company, Pittston Coal Sales Company, Lehigh Navigation Coal Company, Lehigh Valley Coal Sales Company, M. A. Hanna Company, and Delaware and Hudson Coal Company. The three first named distribute their coal in Canada through Canadian subsidiaries or affiliates, while the others are represented in Central Canada by independent concerns, of which the largest are Canadian Import Company Limited, Empire Hanna Coal Company Limited, Scotch Anthracite Coal Company Limited, St. Lawrence Importing and Distributing Company Limited, and F. P. Weaver Coal Company Limited. Anthracite Sales Limited, which also supplies a large quantity of anthracite to the Canadian market, handles principally coals produced by a number of the "off-line" or independent mines in the anthracite fields.

United Kingdom Anthracite

United Kingdom anthracite had a substantial market in Central Canada during the pre-war years, and this trade may revive although its future is uncertain. As it was all water-borne, it had to be handled on docks in somewhat the same manner as the handling of United States bituminous coal already dealt with, except that, arriving by freighter, it required more elaborate dock equipment for unloading. Welsh anthracite was handled principally by the British Coal Corporation of Montreal, a wholly-owned subsidiary of the Canadian Import Company Limited, which is exclusive agent for a sales company in the United Kingdom controlling distribution of nearly 70 per cent of Welsh production. Other firms imported some Welsh coal, but most had discontinued doing so. Scotch anthracite was handled by the Scotch Anthracite Company of Montreal, a subsidiary of the exporter in London. While United States anthracite

degrades only slightly, the softer structure of United Kingdom anthracite, and the squeezing and crushing on the ocean voyage, caused up to 30 or 35 per cent of domestic sizes to degrade to buckwheat and screenings. Much of it was also imported in large lumps, which required the installation of breaking machinery on the Canadian docks, and importers in Montreal have made large investments in plant equipment to break, screen and otherwise prepare this coal for market. British Coal Corporation wholesaled through its parent firm, Canadian Import Company, and through the F. P. Weaver Coal Company. United Kingdom anthracite also entered the Toronto market, being sold wholesale through the F. P. Weaver Coal Company and through Elias Rogers Coal Company Limited and the Milnes Coal Company Limited, both of which also retailed it.

Canadian Coal

Nearly all the Maritime coal entering Central Canada comes from mining subsidiaries and affiliates of the Dominion Steel and Coal Corporation Limited, and it has been the policy of Dosco to market as much of its production as possible without the intervention of any sales agency. About 85 per cent of its sales are direct. It maintains a coal sales department at Montreal and branch offices and salesmen elsewhere in Central Canada, and in the pre-war years it supplied the bulk of the industrial coal in the Montreal area. This coal moves during the navigation season into the St. Lawrence dock terminals at Quebec, Levis, Three Rivers and Montreal. Some is stock-piled and is shipped as required by rail and truck, depending on the nature of the receiving facilities at the point of consumption, and the distance from the supply dock. That going to Ontario is either forwarded from the docks by rail or is trans-shipped into canalers and sent on to water delivery points on the St. Lawrence and the Great Lakes as far west as Little Current on Georgian Bay. Dosco also maintains docks at Toronto where the coal is stock-piled for delivery to consumers and dealers.

Coal from independent Nova Scotia mines and from mines in New Brunswick is shipped into the Montreal area in comparatively small quantities. The movement is almost entirely by rail. It is generally sold through exclusive sales representatives.

Western coal has not been so far of great importance in the Central Canadian market and, as a result of wartime conditions, its supply to that market was greatly curtailed after 1942. When the subventions first commenced many western producers opened sales offices in Ontario, but all but one of these have now been closed. Some sales agents were salaried employees of the mine, but others were paid commissions ranging from 15 cents to 35 cents per ton. Such coal as does come in is shipped by rail direct to the premises of the consumer or the retailer. There have been some sales direct to the consumer, but the bulk of the movement has been through dealers. Western coal found its best market in the northern part of Ontario where competing coal was also delivered by rail. It was widely used there for railway and industrial purposes and was also used extensively for domestic heating, the heating equipment, which was designed for wood, being readily adaptable to western "domestic" coal.

Cost of Wholesaling

The profit taken by the wholesaler or the importer-wholesaler varies considerably, depending on the type of coal and the service he performs. On United States bituminous coal in pre-war days, competition between producers and between distributors resulted in a variety of arrangements. Some coal would be purchased by the Canadian importer and resold by him, both purchase and resale being at the best price obtainable. In some cases there was both a discount and a selling commission. The National Bituminous Coal Act of 1937,

first effective in the Fall of 1940, established minimum prices, maximum discounts and selling commissions, and required contracts with sales agents and wholesalers to be approved. With the establishment of maximum prices by the United States Office of Price Administration, the subsequent expiry of the National Bituminous Coal Act, and the change to a position of short supply, the practice of granting discounts practically disappeared and most sales thereafter were at ceiling price, in which case the Canadian importer simply added his margin to the mine price, the margin varying from 10 cents to 50 cents per ton, depending on the competitive position, the tonnage involved, and the grade of coal delivered. At present, the Wartime Prices and Trade Board limits to 45 cents per ton the total mark-up on bituminous coal shipped by rail to retail dealers. These figures, of course, apply only to direct sales. Where the coal is handled over the importer's docks, the expense of dock handling is added.

During the life of the National Bituminous Coal Act, discounts ranged from about 10 cents per ton, applying usually to railway fuel, to about 50 cents per ton in the case of cannel coal, with some discounts being on a percentage basis such as 6 to 8 per cent of the f.o.b. mine cost of the coal. The general discount to Canadian importers was about 12 cents to 15 cents. In addition, producers sometimes paid commissions to their sales agents amounting in general to 6 per cent to 8 per cent of the mine cost.

United States anthracite is handled on a somewhat different basis. The large producers periodically issue a circular, establishing a price to the retail trade f.o.b. cars at the mine, and the exclusive agent in Canada is generally entitled on all sales to a discount of about 25 cents per ton on domestic sizes and 10 cents to 15 cents per ton on the smaller sizes used in stokers and blowers. Usually a further discount of 5 cents to 15 cents per ton is given for prompt payment, which is invariably passed on to the retailer for prompt payment by him. The coal is normally invoiced to the wholesaler at the mine price less the discount, and the retailer is billed at the mine price. The retailer usually pays the freight and the exchange, if any, on United States funds. As is the case with most wholesale transactions, the wholesaler accepts the credit risk of his customer.

The price of United Kingdom anthracite is to a considerable degree dependent on the price of competing United States anthracite. Examination of financial statements of companies engaged in importing this fuel indicates that it was not unduly profitable business. It would appear, however, that margins allowed to wholesalers for selling United Kingdom anthracite are somewhat in excess of those given by suppliers of United States anthracite.

As has been stated, Maritime coal is largely distributed by the producing company or its affiliates. Dealers wishing to buy this coal normally pay the same price as consumers, except at points where Dosco has no sales office of its own, in which case their coal is distributed through an agency arrangement and a discount ranging from 10 cents to 25 cents a ton is allowed off the established dock price. Dealers supplying apartments, stores, institutions and smaller industrial accounts in places such as Montreal usually take a mark-up of about 25 cents per ton over the Montreal dock price, in addition to their normal delivery charge. In Ontario, wholesalers desiring Dosco coal are given a discount of 10 cents per ton, but compared with margins on other coals it is not sufficient to attract them, except where their customers desire it.

The sales representatives of coal from independent Nova Scotia mines and from New Brunswick mines generally operate on a gross margin of 25 cents per ton, and where sales are through wholesalers no discount is granted.

Where coal is handled by a wholesaler over his own coal dock, his charge is based on the service rendered, depending on whether the coal arrives by bulk freighter or self-unloader, and whether it requires screening or oil-treating. The

actual cost of dock handling of coal probably runs from 25 cents to 75 cents per ton, exclusive of such items as degradation, shortages, interest on the money invested in coal, depreciation and the cost of administration. Due to the many varieties of coal handled over each dock, it is almost impossible to ascertain the exact amount of profit on any particular type of coal handled. Degradation has to be considered in dock spreads, and on a friable coal such as Pocahontas stove sizes considerably more gross margin is required than on a coal where no degradation occurs, as resulting screenings are either lost or mixed with slack and sold at a reduced price for industrial purposes.

The principal operating costs of a dock are rent, taxes, labour, insurance, depreciation on equipment, maintenance and repair, and such miscellaneous expenses as power, light, tools, et cetera, and there are, of course, general supervision and administrative expenses. The majority of these expenses are fixed and bear little relation to the tonnage of coal handled. If a dock can operate for an expense of, say, 60 cents per ton on 130,000 tons, it is probable that this would be closer to $1.00 per ton if the tonnage should drop to 80,000 or 90,000 tons. Then, too, docks handling coal for substantial industrial accounts with a year-round business have a comparatively low overhead and are able to turn over coal on a given space twice or even oftener each year. Dock owners supplying domestic coals for the dealer trade require a great deal more equipment and, as these coals normally enjoy much larger sales in the winter than in the summer, there is not the same rapidity of turnover of inventory, requiring greater use of dock space and requiring that capital be tied up for longer periods in inventories.

Complete financial information was tendered by all of the larger importers but, as their administration expenses include both direct and off-dock sales, it is difficult to ascertain the profits of the dock operations alone. This information, however, does indicate that salaries paid are reasonable and, considering the total tonnage of coal handled and the amount of money employed in the business, the profits are not excessive. They do appear large in many cases in relation to the capitalization of the company, but most wholesale companies, particularly those that are Canadian subsidiaries of United States firms, have capitalized only sufficient to take care of the investment in docks and in coal when their inventories are at the low point, the additional money required in building up inventories being obtained either by bank loans or credit extended by United States suppliers. The net profits of one large importer who maintains docks and handles coal of many kinds, both by direct and off-dock sales, amounted in 1945 to just over 11 cents per ton before tax, and this is probably a fair sample in the case of Central Canada importers. Some of the direct sales of large quantities of coal to consumers of good financial standing appear at times to give a substantial revenue to the wholesaler at very little cost or trouble to him, but it is necessary to look at his over-all operations to determine whether his profit is too high. Due to the fact that most wholesalers deal principally in two or three varieties of coal, often with exclusive contracts, there is a certain amount of dealing between wholesalers, in which event there is some splitting of commissions. This, however, does not appear to be undesirable, as, due to the range of coals required by the market in this area, it is impossible for one dealer to have contacts or be familiar with the entire range.

The Retailer

The established retailer maintains one or more coal yards in the city in which he does business. He has a considerable capital investment in his yards, office, coal storage sheds, screening and treating equipment, weigh scales, and trucks or wagons for delivery. Some of the larger yards have costly installations for unloading railway hopper or dump cars direct into storage bins, or have

crawler cranes for the same purpose. Others unload onto the ground and use portable conveyers to transport the coal to the storage area or bin. The smaller retailers unload and store the coal by hand labour. A retailer may handle as many as eighteen or twenty different types and sizes of coal and two or three sizes of coke, requiring at least that many storage bins. The amount of equipment depends entirely on the financial position of the retailer and whether the tonnage involved justifies the expense.

Many retailers throughout Central Canada have acquired agencies for oil-burning equipment, and some have installed oil storage tanks. The trend to automatic stokers has also put them in many cases in the stoker business and has changed, to some extent, the type of coal which they handle.

The retailer is usually licensed by the town or city in which he operates. In some cities he must have his weights checked at city weigh scales and furnish a city weight ticket along with his own invoice, while in others he is subject to spot checking of weights by the local police. The retailer sometimes purchases his coal direct from the mine, but in most cases from a wholesaler with whom he establishes a contact. Even large retailers indicate that there is no special advantage in buying direct. Water-borne coal may be trucked to the retailer's yard from the docks in the dock operator's vehicles. More often it will be picked up at the docks by the retailer's trucks, sometimes being screened, treated and bagged on the premises of the dock owner, and being transported direct to the domestic consumer without going near the retail yard. In the case of yards located at considerable distance from the dock, it may be brought to the yard in large heavy-duty trucks or truck-trailer combinations maintained by the retailer. Rail-shipped coal is usually consigned direct from the mine to the yard of the retailer, and there unloaded and placed in storage or, if he has no siding facilities, it will be trucked to his yard from the railroad siding in his town.

A large retailer in a city like Toronto will handle possibly 50,000 to 100,000 tons of coal a year, and in smaller towns the retailer's tonnage may be as low as a few hundred tons. In the former case he will deal in a considerable quantity of coal for commercial enterprises such as apartments, stores, theatres and office buildings and small industries requiring less than about 200 tons per year. The smaller retailer may supply domestic requirements only.

Only in the case of the larger retailer in the more populous centre will his activities be confined to coal and other solid fuels. Most of the smaller yards, particularly in the rural areas, deal in a variety of other products, generally some commodity with which the coal business can be combined. Commonly, the retailer deals in building products, or he may deal in such things as grain and feed or ice, all of which require storage space and trucks for deliveries.

There are in Central Canada about 3,400 licensed retailers. It is estimated that there were in Toronto before the war 300 coal dealers, which figure has now dropped to about 150. During the depression years many individuals, owning a truck used in general hauling or on construction work during the summer, made a practice of coming into the cities in the Fall where, with no establishment other than a truck and a telephone, they engaged in the coal business, purchasing coal in small lots for delivery direct to the consumer. They could earn in this way somewhat more than by letting their services and their trucks to some established concern. Known to the coal trade as "snowbirds", these individuals were considered to give unfair competition to established dealers, as, maintaining no offices, storage space or staff, they were able to cut prices below the minimum required by a year-round business and possibly forced out of business some established retail concerns. The availability of more remunerative employment did much to eliminate this competition, and it completely disappeared in Toronto and many other larger centres by municipal regulations requiring the possession of some storage space and the maintenance on hand of a certain quantity of fuel as a prerequisite to obtaining a retail licence.

At many points on the Lakes or the St. Lawrence, retailers act as their own importers, maintaining storage docks and taking for themselves what profit there may be in dock handling. In some cases they may also have an interest in a ship, enabling them to share in the profits of transporting their own coal. Such cases, however, are unusual. Most retailers do not concern themselves with anything but the retail trade.

The retailer must, in the case of coal passing through his yards and screened and treated by him, take such loss as there may be on degradation and find means of disposing of the resultant screenings in the same manner as outlined previously in the description of dock operation. This is not a particular problem with the smaller retailer handling principally rail-shipped anthracite but is a very important item to the retailer who handles any large quantity of bituminous coal for domestic use.

A typical large retailer, handling over the last six years tonnages ranging from 50,000 to 100,000 tons per year and practically all of whose coal was brought in by rail, showed net profits before tax running from 87 cents per ton down to a low of 16 cents per ton. This variation is accounted for by the fact that the expenses in handling, particularly labour costs and the cost of maintenance of equipment, have risen rapidly, while the stabilized price has prevented this increase being passed on to the consumer. The tonnage of coal used by domestic consumers in recent years has been far in excess of the consumption in pre-war years, and this has enabled the retailer to operate on the pre-war margin notwithstanding increased costs.

The retail-dealer "spread", including cartage, storage, screening, and all work incidental to the delivery of coal into the consumer's premises, ranges, in the larger centres of population in Central Canada, from 90 cents to $3.50 per ton. This depends on the type and quantity of coal involved, the amount of preparation required, the method of delivery, and the area served. In some cities and towns coal is delivered principally in bulk and is placed by a chute or by a small portable conveyer into the basement of the consumer. In many of the largest cities most of the coal has to be delivered in bags; in some cases, in Montreal for example, it frequently has to be delivered to a third or fourth floor apartment. In some places the charge for bagging is included in the standard price, with occasionally some discount for bulk delivery. In other cases the retail price excludes bagged delivery, a special charge of 50 cents per ton or thereabouts being made for bagging. Sometimes an additional charge is made if delivery of bagged coal is required at other than ground floor or basement level. In rural points the farm trade is important, a discount of about 50 cents per ton being given generally when the farmer takes delivery of the coal in his own truck or wagon at the retail yard. Information secured as to retail spreads in urban centres in the United States indicates that Canadian spreads are at least as low. The retail business is highly competitive. The retailer occupies a position which is essential in the distribution of coal, and his profits do not appear to be in any degree excessive.

Before leaving the subject of the retailer in Central Canada, it might be well to deal briefly with the effect on his business of the various government control measures. He was obliged for a time, by order of the Coal Controller, to deliver fuels of a lower classification with superior fuels, in order to spread the available quantity of select domestic coals as far as possible. This entailed an additional amount of labour in loading coal at his yard, as weights of each type of fuel must be checked and the load must be taken from more than one bin.

The retailer is also obliged, on account of the subsidy plan, to do additional bookkeeping, which entails considerable additional cost. He must report periodically to the Dominion Bureau of Statistics with respect to his sales and his stocks on hand, and he must keep a record of all transactions to support his

claim for subsidy on sales to domestic consumers. This is not a problem to him in the case of anthracite bought through a wholesaler, for this coal, all of which is classed as consumer goods, is billed to him by the wholesaler at the mine price less the appropriate subsidy; but in the case of bituminous coals he is billed at the mine price and he must transmit to his wholesaler or direct to the Commodity Prices Stabilization Corporation such supporting material as is necessary to enable his claim for subsidy to be made. Reference may be made to the chapter on Government in Relation to the Coal Industry for an explanation of the import subsidy.

The following table shows the items going to make up the retail prices of United States anthracite in Montreal and Toronto as of September, 1946. Due to the wide range of bituminous coals and the widely varying prices and margins in the basic period, any figures given with respect to such coal might be misleading.

—	Toronto	Montreal
	$	$
Mine price (line mines, nut and stove size)	10.15	10.15
Wholesale commission	(Included in price)	(Included in price)
Rail freight	3.57	3.75
Exchange	0.05	0.05
Duty	0.50	0.50
Laid-down cost	14.27	14.45
Less subsidy	1.91	1.91
Net cost to dealer	12.36	12.54
Retail margin	3.14	3.71
Retail selling price	15.50*	16.25

* Includes bagged delivery.

MARITIME PROVINCES

The distribution of coal in the Maritimes varies somewhat from that in Central Canada. Most of the coal consumed is produced in the Maritimes and is usually sold by the management or the sales department of the producing company without the intervention of any outside selling agency. Of the coal that is imported, most arrives normally in bulk freighters and requires a different method of handling.

Wholesale Distribution

Imported Coal

The functions of the importer-wholesaler, who deals mainly in coal from Great Britain or the United States, are the anticipation of requirements with respect to quantity and grade, the contracting for the movement of the coal from the foreign ship-loading point to the retail dealer or consumer, and the financing of the coal purchased. Under his supervision, and financed by him, ships must be chartered, insurance placed and cargo discharged. He must also provide dock space to store and handle 5,000 to 7,000 tons of coal. He must also provide re-screening facilities. When fuel is imported by such a firm for distribution to the retail trade, the selling price must include the expenses of these items and also take care of the degradation of the higher-priced stove sizes to the lower-priced nut, pea and fines, the latter grade selling at less than cost.

In Nova Scotia the principal importers are S. Cunard and Company Limited and A. T. O'Leary Company Limited, which lease or own dock space in Halifax and represent European and United States suppliers. Both companies will arrange not only to load ships at foreign ports and discharge them at this port, but will also, as tonnage requirements permit, arrange for small cargoes to discharge at smaller ports in Nova Scotia and Prince Edward Island.

The Cunard Company also operates as retail dealer in the Halifax area, while the O'Leary Company engages in the coal trade solely as importer and wholesaler. Both companies sell their screened product, as required, to retail dealers throughout the Maritimes, either over their own docks or from ships discharging at other ports in Nova Scotia or Prince Edward Island.

In New Brunswick the chief port of entry for water-borne imported fuels is Saint John. The chief importer-wholesalers are C. R. Nelson Limited, R. P. and W. T. Starr Limited, Eastern Coal Company, Consumers' Coal Company, and Parker D. Mitchell Limited; the first named being the exclusive representative for New Brunswick for one Welsh supplier, the others purchasing their requirements through other Canadian representatives. All of these firms also engage in the retail trade in Saint John, and each firm imports United States fuels by water for distribution in a similar manner. Most of the imported fuel is anthracite. On receipt, the coal is trans-shipped by truck or by railway car either direct to the consumer or to the retailer's stock bin, and later to the consumer as required.

As most of the coal imported into the Maritimes is water-borne by bulk freighters and as the docks do not generally have the same facilities for unloading coal as is the case in the more populous centres of Central Canada, the greatest risk in arriving at the price is in estimating demurrage and discharging costs. Demurrage will vary with each shipment, depending on the availability of cargo on arrival of the ship at the loading port and on the availability of dock space and labour at the port of discharge. The structure of the ship will also be a factor, as discharging costs will vary with its type, depending on whether a greater or lesser number of men are required in moving out the coal from parts of the ship difficult of access. The gross margin for importers has been difficult to determine accurately, due to the consolidation of the coal import with other business of the same firm such as retail selling, shipping, bunkering and allied interests. It is estimated, however, that the gross margin over c.i.f. costs covering the discharge of the coal, storing and handling on the docks, loss through degradation, and all services up to the delivery to trucks on the docks, would be in the neighbourhood of $3.00 per ton.

While the foregoing describes the importation of coal into the Maritimes as it existed prior to the war, practically all coal now entering the eastern provinces, due to the shortage of shipping space, is carried by rail.

Canadian Coal

The distribution of Canadian coal, chiefly bituminous coal with some quantities of coke, is generally conducted by sales departments of the producing companies, the largest being Dominion Coal Company Limited distributing coal from the Dominion, Old Sydney, Acadia, and Cumberland coal companies, and coke from the Dominion Steel and Coal Corporation. Sales offices located throughout the Maritimes receive orders and forward them to the producing companies. Deliveries are usually made by water, rail or truck direct to the industry or the railways, while fuel for domestic use is distributed by a retail dealer ordering his fuel through the sales office. In Halifax and Saint John the Dominion Coal Company maintains dock space, either wholly-owned or owned by an exclusive representative, to which shipments are made by water, discharged on the dock, and screened (if necessary) for loading into dealers' trucks.

Coal for bunkering requirements is largely distributed by the Dominion Coal Company and by coal importers who maintain facilities for this at larger ports in the Maritimes.

Of the independent bituminous producers, two firms contract with a wholesaler to market their output in selected areas, each company reserving the right to market its fuel to the railways and to areas not covered by the contract. The remaining independent producers distribute their output in a manner similar to that of the Dominion Coal Company, each company handling its own sales direct, usually by rail movement, to industry or to retail dealers for further distribution to the domestic consumer. Inland districts not served by rail or by water transport rely on truckers for the distribution of coal. A trucker delivering some commodity in the area in the neighbourhood of a mine, or of a dealer, will usually arrange for a return load of coal for a party or parties in his operating area. The wholesaler, representing Canadian coal in a given area, being concerned only with selling expenses and financing, will not require as much capital in connection with coal distribution as will an importer. His expense is usually covered by a gross margin averaging 45 cents per ton.

The Retailer

As elsewhere, the retail dealer in the Maritimes must anticipate the needs of the consumer, maintain coal handling facilities, and keep a sufficient supply of the various grades of fuel on hand to meet the immediate needs of the domestic purchaser. He must provide for the delivery of fuel from his storage area to the consumer's bin by truck or cart, in bulk or in bags, must generally finance the purchase of carload lots, and must assume the retail credit risk.

The tonnage handled by dealers in the Maritimes is relatively small in in comparison with the total coal sold. This results in a net profit too small to enable the retailer to carry on business solely as a coal dealer. As is the case in Central Canada, many retailers engaged in other business such as the handling of building supplies, hay, feed and flour, and through diversification of sales, are able to offer coal at a lower cost than would otherwise be the case. The cost of coal to the retail dealer is, in the case of imported coal, f.o.b. cars or trucks at the point of discharge, and in the case of Canadian coal, f.o.b. trucks or cars at the mine. The retail dealer determines the selling price by adding to the above, freight, overhead administration, truck charges and profit. His gross margin, including all of these items except freight, generally averages about $3.00 per ton. Where coal has to be bagged, an additional charge is made for this service, so this is not considered by the retailer in arriving at his selling price. Examples of the price paid, in September, 1946, by the consumer in Halifax on some commonly used varieties of coal, with a break-down of these prices into the various component parts, is as follows:

—	Dominion Screened Lump	American Anthracite (line mines)
	$	$
Mine price	7.95	10.15*
Freight	1.60	7.96
Exchange	.....	0.05
Laid-down cost	9.55	18.16
Less subsidy	.....	2.66
Net cost to dealer	9.55	15.50
Retail margin	2.70	3.00
Retail selling price	12.25	18.50

* Including wholesale margin.

THE PRAIRIE PROVINCES

Wholesale Distribution

The distribution of coal in the Provinces of Manitoba, Saskatchewan and Alberta varies somewhat from the patterns prevailing in Central Canada and the Maritimes. In the first place, except for a small volume of United States coal, the consumption of which is confined to Winnipeg and the areas east of that city, practically all of the coal consumed on the Prairies comes from mines in Saskatchewan, Alberta and the Rocky Mountain section of British Columbia. It is all shipped by rail and the wholesalers do not as a rule take delivery of any coal but occupy the position of broker. As the "domestic" mines in Western Canada are usually small and their market is scattered it is difficult for a single mine to take care of its own wholesale distribution.

The wholesaler usually has salesmen throughout the western provinces and at the coast who can approach the consumer with a full range of coals. Some of the large wholesalers own or control mines in the West and are interested primarily in building a market for their own coal, although they do handle other coal under contract from the producer, exclusive or otherwise. Other wholesalers largely operate under some kind of exclusive arrangement with several mines, so they have sufficient coverage to supply the requirements of their customers. Some of the producers have their own selling agencies, handling only coals produced by their particular mine.

One of the chief functions of the wholesaler is financial. The producer, being often a small operator, may be dependent on the orders shipped during the month to meet his current payroll. The usual practice is for the wholesaler to pay on the fifteenth of the month for all coal shipped on his orders during the preceding month. In return, he bills the retailer, giving him usually thirty days, but in case of necessity sixty or ninety days, in which to pay.

An important function of the wholesaler is the encouragement of "off-peak" buying. To enable the operators to keep at least a skeleton staff of well-trained men in the mines during the summer, developing the mines for further production during the following winter, a market for the coal thereby produced must be found. The wholesaler, therefore, endeavours to have his retail customers stock their bins during the summer months. During the war years, as householders became aware of the coal shortage and practised summer buying, this constituted no problem, but it was a very real problem during the depression years before the war when the operation of practically all western "domestic" mines was on a seasonal basis.

Winnipeg is the largest consuming point in this section and there are about nine or ten wholesalers in that city, some of the largest of whom, being also large scale retailers, do some stocking in their retail yards for wholesale purposes. One, at least, of the large Winnipeg wholesalers maintains on his staff a qualified combustion engineer for the purpose of advising customers or potential customers.

United States coal is supplied to the Winnipeg market largely by two concerns, James Murphy Coal Company of Fort William which has a dock at that point and a selling agency in Winnipeg, and the Empire Hanna Coal Company which has a Winnipeg office but does not maintain a dock, paying instead a dock handling charge at Fort William. United States coal, which at one time dominated the Winnipeg market, by 1939 had been almost entirely supplanted by coal from Alberta, Saskatchewan, and the Crowsnest Pass region in British Columbia, Saskatchewan coal in more recent years having become a widely used industrial fuel.

The railways purchase most of their coal from about a dozen mines producing bituminous coal in the mountain sections of Alberta and British Columbia. They usually buy direct from the mines, no sales commission being paid. Complaints are frequently made that the mass buying power of the railways enables them to depress unduly the price paid to the producer and that they virtually set the price they pay for coal. It would seem, however, that whatever powers in this direction they possess, their larger suppliers in the West are in a somewhat better financial position than is the western coal-mining industry in general. Railway purchases of fuel for stations, roundhouses, et cetera, are from various mines, their business distributed partially on the basis of the amount of freight originating from those mines.

Farther west, in the coal-mining areas, very little coal is sold locally through wholesalers. The producers in most cases, even when an exclusive distribution contract exists, exclude direct sales from the mines and, as the Alberta "domestic" mines cover a very wide area, a substantial tonnage of coal is sold to truckers, farmers and local consumers, and hauled direct from the mine. Truckers can supplement their income with this type of business, and in the years immediately prior to the war constituted a severe threat to both the railways and the retail dealers. Frequently the trucker found it very convenient, when he happened to be in the neighbourhood of a mine delivering a load of some other commodity, to pick up a load of coal for delivery to a particular customer or in the expectation that he would be able to sell his coal when he returned to his home district. This gradually developed into a fairly substantial business. Some years ago, to meet this competition, the railways introduced special rates into areas largely served by truck, and the dealers agreed to reduce their margins of profit to co-operate with the railway. With the advent of the war, the shortage of trucks put an end to this type of competition, but it may develop again with a return to pre-war conditions.

There are about fifty wholesalers handling western coals, either on an exclusive or a jobber's basis. The wholesaler's gross profit ranges from about 41 cents per ton on United States coal down to an average of 25 cents on western coal. One large wholesaler, dealing exclusively in western coal and owning or controlling producing companies in both the Saskatchewan and Drumheller fields, charges a straight margin of 15 cents per ton on all coal produced by its companies. It is doubtful if it would be possible for the company to operate on this margin were it not for large bulk sales, including sales to the railways from its Saskatchewan mine. It would probably be fair to say that the margin ranges from 10 cents to 35 cents per ton, depending on the type of coal and whether the order is for a single car lot to a remote district or by daily delivery to a bulk customer.

The handling of coal by the companies engaged in the grain trade in western Canada, about which more will be said under the heading Retail Distribution, represents a variation from the general pattern and is peculiar to that section of the country. A number of such companies some years ago formed a wholesale coal agency now operating under the name of the Occidental Coal Company Limited. Unlike most wholesalers who have exclusive contracts with producers to promote sales of their coal, this company acts principally as an agent of the buyers, its member grain companies having some hundreds of retail outlets in the three Prairie Provinces. It takes the same spread, generally 25 cents per ton, as do the other wholesalers, but its expenses of operation are small as it maintains no salesmen on the road. The financial risk taken is negligible, since practically all of its sales are to its member companies and its income is consequently large in relation to the capital employed. Most of this income is distributed to the member companies on the basis of the tonnage of coal purchased by each during the year. This company operates, as do other wholesalers, in buying coal and arranging for direct shipments to the retail point but, unlike

most, it also takes care of the freight charges. Criticism has been levelled at this company by producers and other wholesalers, claiming that it simply forced a reduced price because of its mass buying power. Two of the largest of the grain companies are not shareholders in Occidental but, in normal times at least, probably obtain trade discounts similar to those granted to wholesalers due to their volume buying. Occidental, through the combined volume of its member companies, is however in perhaps a better position than any of its members would be individually to obtain favourable prices from the mine. Other wholesalers with exclusive contracts from particular mines frequently sell to Occidental, in which case they are obliged to divide their commissions with that company. An order of the Coal Administrator issued in the summer of 1946 has permitted the mines to re-negotiate their contracts with wholesalers in the light of present-day marketing conditions, notwithstanding the general provision in the Maximum Prices Regulations prohibiting any variation in special trade discounts granted during the basic period. This may eliminate some commissions to companies like Occidental during periods like the present when the coal produced can find a ready market. Where Occidental purchases through other wholesalers and the commission has heretofore been split, this order may have the effect of increasing (at the expense of Occidental) the net profit to the wholesaler holding the exclusive contract with the supplying mine. The Occidental Company handled during 1945 more than 300,000 tons of coal.

It has been suggested that a central selling agency might be desirable, eliminating some wholesalers and reducing the cost of marketing coal. Though a central selling agency might reduce to some extent wholesaling costs, individual producers might suffer under the scheme. An energetic and efficient producer would obviously be reluctant to be under compulsion to share his market with a less efficient producer. In any event, any improvement in this direction must rest with the producers and, if the scheme is desirable, it can be effected by the producers themselves. With respect to sales in Ontario of domestic coal, assisted by transportation subvention, some system of unified selling might be desirable.

The average wholesaler handles coal from possibly six or seven different companies, his tonnage ranging from 100,000 to 200,000 tons per year. Shipment is made by carload lots and coal is billed to the wholesaler and re-billed to the customer with the margin added, or is billed direct to the consumer at a price including the wholesaler's margin which is paid to him later by the mine.

The wholesaler undoubtedly plays a useful part in the distribution of western coal, and the gross margin for the service rendered does not appear to be unduly large. The records of one large wholesaler show a gross profit on sales of a little over 5 per cent and a net profit of less than 1 per cent. Net profit of the average large wholesaler appears to be about 5 cents per ton before making provision for income tax.

Retail Distribution

Retail distribution in Western Canada does not vary greatly from that in other parts of Canada except that, unlike some of the cities in Eastern and Central Canada, delivery in bulk without bagging can be made in most Prairie cities and towns. Winnipeg is an exception. There, most coal for household use is bagged and apparently no extra charge is made for this service, the competitive position of Winnipeg retailers having, before the stabilizing of price in 1941, established the practice of quoting the same price for bagged as for bulk delivery.

Like retailers in Ontario and Quebec, most of those on the Prairies find it impossible to make coal their sole business. Most of them deal in ice, engage in general hauling, or handle gravel or other commodities to keep their delivery trucks occupied during the summer. They may also handle building products

or feed. The largest retailer in Winnipeg would handle about 50,000 tons of coal a year and have considerable equipment for unloading cars and storing and treating the coal. The average retailer would probably handle 5,000 to 10,000 tons, while in the small Prairie points the tonnage might be no more than a few hundred tons.

Perhaps the principal difference between the retail distribution of coal in the Prairies and that elsewhere is the position occupied by the grain trade. The grain companies, which maintain siding facilities and have weigh scales in connection with their grain business, saw many years ago the possibilities inherent in the handling of coal as a means of encouraging farmers to deliver grain to their elevators. It was a simple matter to build a coal shed adjacent to the elevator where farmers might, after unloading their grain, fill their wagons with coal for the return trip to the farm. At many points on the Prairies the operator of the local grain elevator is the only retail coal dealer, his competition having prevented others from entering the coal business. There are in the three Prairie Provinces more than 1,600 of such outlets, of which about 1,100 are operated by the "line" elevator companies and about 500 by the United Grain Growers and the Wheat Pools. The coal operations of the grain dealers have been conducted on a very modest margin as they involve practically no additional labour, the coal not being treated in any way but simply delivered in bulk into the wagon of the farmer. Their margin runs as low as $1.00 to $1.50 per ton.

Apart from the coal handled in bulk as by the elevator companies, the established coal dealer must service the coal in much the same way as he does in other centres, although the coal, being rail-shipped and not subject to breakage to the same degree as water-borne coal, screening is not usually required. The coal will, however, be "forked" when being loaded into delivery trucks.

The margin to the retailer other than the grain dealer runs in Winnipeg from $3.50 a ton on Coalspur coal down to $2.55 a ton on Saskatchewan lignite, with a prevailing spread of $3.25 per ton on the top grades of Drumheller coal. The margin probably averages $3.00 a ton in the larger centres throughout the Prairies.

During the depression years, when the western mines were lacking markets, there was a great deal of price cutting and almost anyone requiring a substantial quantity of coal could command a preferred price. This resulted in an unduly depressed price to the producer. During this period also competition from the grain trade and from the consumer co-operatives, who were able to sell on a small margin, and from the "snowbirds" who operated in the same manner as those in Central Canada, as outlined in the section dealing with that area, or who occasionally brought a car of coal to a given Prairie point and sold direct from the car, depressed the retail price of coal to the point where many retail dealers were obliged to discontinue business.

Winnipeg prices of some coals in common domestic use are as follows, the items making up the prices being shown:

—	Saskatchewan Shaft-lump	Saskatchewan Strip-lump	Drumheller Standard lump
	$	$	$
Mine price* (including wholesale margin)	2.25	1.60	5.15
Freight	2.30	2.30	4.70
Retail margin	2.65	2.55	3.25
Retail Selling Price*	7.20	6.45	13.10

* These prices do not include the increase granted by orders of the Coal Administrator made during October and November, 1946.

THE PACIFIC COAST

This coal market is divided between Vancouver Island mines, the greater part of whose tonnage is controlled by Canadian Collieries (Dunsmuir) Limited, and the mines of Alberta and the Rocky Mountain and inland regions of British Columbia. As indicated in the chapter on Markets, the principal consuming area in the Province is Greater Vancouver and, while for many years the Island mines dominated that market, the demand for Alberta coal has increased greatly in recent years, leading to the acquisition in 1941 of the assets of McLeod River Hard Coal Limited at Mercoal, Alberta, by Canadian Collieries (Dunsmuir) Limited.

Before the war the Island mines supplied about 100,000 tons annually to the railways, but the diversion of fuel oil supplies and the shortage of wood fuel meant increased domestic coal requirements, and the railways were obliged to use for their requirements coal from the steam coal mines of Western Alberta and the Crowsnest Pass.

Wholesale Distribution

Except for the domestic market, sales in the Coast area are made direct by and from the mine to the consumer, without the intervention of any marketing agency. There being no great concentration of industry as is found in Central Canada, and cheap water transportation being normally available from the Californian and South American oil fields resulting in the use of that fuel in substantial quantities in industry, it has not been necessary to stock-pile coal in quantity to serve the industrial market. The uniform distribution practice, therefore, is direct shipment from the mine to the industrial plant. The plants being generally located on water, the coal scows from the Island mines are unloaded directly onto the premises of the consuming industry.

Canadian Collieries serves the domestic market with both Island and McLeod River coals through the medium of its subsidiary and selling agency, Vancouver Island Coals Limited. This company in 1931 entered into an agreement with the firm of Evans, Coleman and Evans Limited, and its several affiliated companies dealing in coal and owning or having under lease docks with storage and coal handling facilities and equipment at various points on the Vancouver and New Westminster waterfronts. The object of this agreement was to reduce the price of Vancouver Island coal to meet the growing competition from Alberta coal by providing a more efficient and uniform method of grading and distributing it. Under this agreement, the responsibility for grading the coal was with the producers, but the handling of coal from the scows to the retailer was done by the "associated companies" at a fixed price. The agreement provided for payment of a rental of 40 cents per ton for all coal handled over the docks in any year, with a reduction to 20 cents on tonnage in excess of 75,000, and the associated companies were to be paid handling charges for unloading, handling, screening, weighing, sacking, and delivery into trucks, ranging from 90 cents per ton on sacked coal, including provision of the sacks, down to 25 cents per ton for pea and fines in bulk. The sales agency was allowed to fix the retail delivered price above which the associated companies and their dealers could not sell, these companies to pay the sales agency for the most popular grades of domestic coal loaded on trucks at the prevailing retail price less $1.70 per ton. The sales agency reserved the right to sell direct, and it does so in the case of large consumers as outlined above.

The sale of Alberta coal in the coastal area is largely confined to domestic coal, and the manner of distribution is the same as that prevailing in the Prairies. There are several wholesale agencies operating in Vancouver and handling

Alberta domestic fuel, one of the largest of these being Coal Sellers Limited. They generally handle a variety of Alberta coals, charging commissions ranging from 5 cents per ton to 35 cents per ton, depending on the grade. Some of the Alberta coal mining companies have their own sales representatives in the coast city and do not operate through wholesalers. None of the wholesalers takes delivery of any coal but arranges to have it shipped direct to the industrial consumer or to the retail dealer.

Retail Distribution

Retail distribution in Vancouver is probably a simpler matter than in most cities, due to the fact that, at least with respect to the tonnage procured from Vancouver Island Coals Limited, the screening and sacking is done at the coal docks as above set forth, and the retailer simply has his truck loaded at the dock for delivery to the customer. This led during depression years to a very large increase in the number of retailers, many without yard facilities, and inevitably to the attendant price cutting.

The coal dealer, however, is still obliged to maintain yards for the handling of rail-shipped coal originating in Alberta, and the handling of such coal is in no way different than the handling of the same coal on the Prairies except that practically all domestic coal in Vancouver area requires to be bagged. The margin taken by the retailer ranges from $1.20 per ton on some Vancouver Island coals to $3.50 per ton on higher grades of Alberta coal, the latter price including bagging.

Mine prices, freight and retail margins on typical domestic coals sold in Vancouver are as follows:

—	Wellington Lump	Drumheller Lump
	$	$
Mine price[1]	9.80[2]	4.90[3]
Freight	....	4.35[4]
Retail margin	3.25[5]	3.25[5]
Retail selling price	13.05	12.50

[1] These mine and retail prices do not include the increases granted by orders of the Coal Administrator made during October and November, 1946.

[2] Price delivered on Vancouver docks.

[3] Discount of 25 cents from mine price of $5.15 on coal shipped into subvention area. Permission granted in summer of 1946 to discontinue this discount.

[4] Freight rate is $5.00 less subvention of 65 cents. Subvention withdrawn December 1, 1946.

[5] Includes bagged delivery and, in case of Wellington lump, includes all dock services.

CHAPTER VIII

SOURCES OF ENERGY

Coal is important principally because it is a source of energy. Almost all the coal used in Canada is burned to produce heat and heat is a form of energy. The energy thus obtained may be used in the form of heat as, for example, in space heating, or it may be converted by various means into mechanical energy as, for example, in railway locomotives. Compared with the amount of coal used as a source of energy, that amount used as a raw material for non-energy purposes is very small.

Although coal is an important source of energy in Canada, it is not the only important source; we also obtain considerable amounts of energy from water power, petroleum, wood fuel and natural gas. All these other sources except water power are like coal in that they are stored potential heat; in common with coal, these materials will, under favourable circumstances, react chemically with oxygen, releasing thereby substantial quantities of heat. Water power is different. The cycle of evaporation, condensation and precipitation provides, under favourable circumstances, an opportunity to use the gravitational pull on water collected above sea level to develop mechanical energy. The mechanical energy thus made available may be used as such or, as is more common, it may be converted into electrical energy for transmission purposes, and then converted to the type of energy required at the point where the energy is used.

There are a number of other sources of energy, not now important but some of which may in time become so. For many years there has been a good deal of interest in the possibility of generating electricity from tidal power in the Bay of Fundy. The use of tidal power appears to be practicable, but the recent report of H. G. Acres & Company on tidal power in the Petitcodiac and Memramcook estuaries, made to the Dominion Department of Mines and Resources, suggests that other sources of energy will continue to be cheaper. There has been considerable attention paid on this continent to the possibility of using solar radiation for space heating, but with little direct application so far in Canada. Very recently there has arisen the possibility of the peacetime use of atomic energy. So much attention has been paid to this possibility that some comment will be made on it later. There are various other sources of energy which, though interesting to speculate about, seem to offer little prospect of successful exploitation in Canada at present. Included among these sources are the earth's internal heat, terrestrial temperature differences and atmospheric electricity. A further source of energy, the wind, is used to a very limited extent in Canada. It is now much less important than it was in the days of sailing vessels and its importance will probably continue to decline.

During recent years several attempts have been made to estimate the energy obtained annually in Canada from various sources. All such estimates are no more than rough approximations and they all suffer from the fact that the statistics on wood fuel consumption are not adequate to allow that source to be included in the estimates. This is unfortunate for wood fuel is in Canada an important source of energy, providing in some years as much as perhaps 10 per cent of the energy obtained from all sources. However, estimates of total energy obtained from water power and the mineral fuels are useful as an indication of the change from year to year in Canada's energy requirements and of the relative importance of the sources included.

The best estimates of energy obtained from water power and the mineral fuels are those published by the Bank of Canada in its Statistical Summary of October-November, 1946, covering the years 1926 to 1945, inclusive. These

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estimates are reprinted in the Appendix to this report. Inasmuch as the following paragraphs are based on them, and inasmuch as the estimates are somewhat arbitrary, the method used in making them should be understood. The first step was to estimate the consumption in Canada of coal in pounds, petroleum products in gallons, natural gas in cubic feet and water power in kilowatt hours of electricity. The second step was to reduce each of the physical amounts to a common denominator, the British thermal unit. In the case of fuels, the conversion to B.t.u. was achieved by multiplying the number of physical units by the number of B.t.u. which, under ideal conditions, each unit would liberate during combustion. In the case of water power, primary and secondary power were treated separately. The conversion to B.t.u. of primary power was achieved by estimating the quantity of coal that would have been required to generate the same amount of primary electricity as was in fact generated hydraulically and then converting that amount of coal into B.t.u. Secondary power was converted at its actual B.t.u. equivalent.

In the period since 1926 the amount of energy obtained annually from water power and the mineral fuels has fluctuated rather violently. Letting the energy used in 1926 be 100, the use of energy dropped to 85 in 1933 and rose to 175 in 1944. The annual variations are due to a number of factors, the most important undoubtedly being fluctuations in the level of business activity. During the depression years of the early 'thirties, business conditions were unfavourable and the wheels of industry turned only slowly or stopped altogether. Under such conditions, relatively small quantities of energy were required. During the last six years the reverse has been true. The demands of war were enormous, production rose rapidly and energy requirements rose accordingly. A close relationship is to be expected between energy used and any index of the level of economic activity. One such index is that of total employment in eight major industries, published by the Dominion Bureau of Statistics. The relation between that index and energy obtained from water power and the mineral fuels is shown in Chart D. Both variables are plotted as index numbers on the base 1926 = 100.

The closeness of the relationship of these two variables is quite impressive. It indicates that energy requirements vary directly with and proportionately to the volume of employment. The nature of this relationship is of particular importance in connection with any forecast of energy requirements. If employment is high, we shall require a relatively large amount of energy; if it is low, we shall require very much less. Furthermore, if employment fluctuates considerably from year to year, energy consumption may be expected to fluctuate similarly. The problem of stabilizing energy requirements is substantially the same problem as stabilizing the level of employment.

Coal is the major source of energy used in Canada, providing more than one-half of the energy provided by water power and the mineral fuels. Next in importance is water power. The importance of water power as a source of energy is much greater than is generally realized. It has provided substantially more energy in most recent years than have the Canadian coal mines. Over the last decade it has furnished nearly 30 per cent of total energy obtained from water power and the mineral fuels. Petroleum ranks next after water power and is about one-half as important a contributor to Canadian energy needs. The amount of energy obtained from natural gas is relatively small in comparison with the total, largely because the areas in which it is available are more limited. Wood fuel as a source of energy ranks between petroleum and natural gas, probably rather nearer to the former than the latter in importance. Chart E shows the relative importance of water power, coal, petroleum and natural gas as sources of energy in each of the years 1926 to 1945. In the case of both coal and petroleum, home-produced fuel and imported fuel are shown separately.

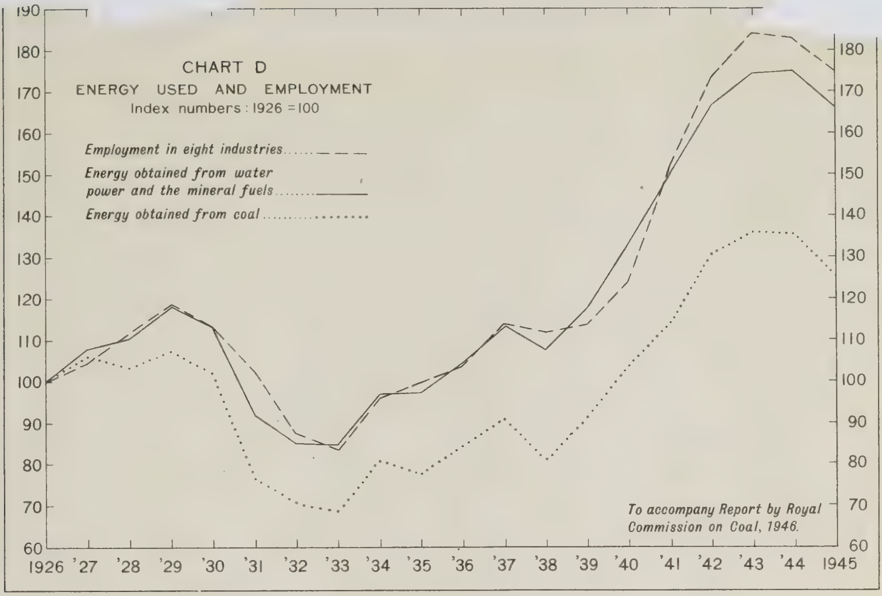
CHART D
ENERGY USED AND EMPLOYMENT
Index numbers: 1926 = 100
Employment in eight industries
Energy obtained from water power and the mineral fuels
Energy obtained from coal
To accompany Report by Royal Commission on Coal, 1946.
1926 '27 '28 '29 '30 '31 '32 '33 '34 '35 '36 '37 '38 '39 '40 '41 '42 '43 '44 1945

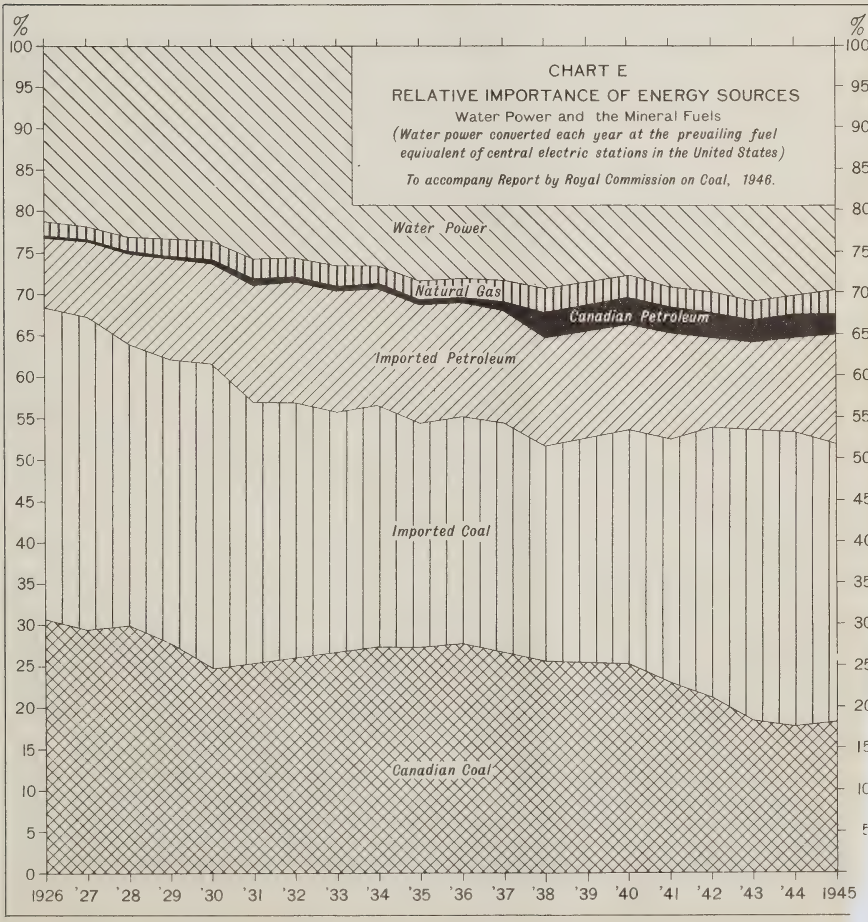
CHART E
RELATIVE IMPORTANCE OF ENERGY SOURCES
Water Power and the Mineral Fuels
(Water power converted each year at the prevailing fuel equivalent of central electric stations in the United States)
To accompany Report by Royal Commission on Coal, 1946.
%
Water Power
Natural Gas
Canadian Petroleum
Imported Petroleum
Imported Coal
Canadian Coal
1926 '27 '28 '29 '30 '31 '32 '33 '34 '35 '36 '37 '38 '39 '40 '41 '42 '43 '44 1945

The estimates on which Chart E is based ignore any difference at any one time or any changes over the years in the efficiency with which the various sources of energy are utilized. To the extent, therefore, that one fuel is normally utilized more efficiently than another, the importance of the first fuel is understated and of the second overstated in the chart. Also, to the extent that the efficiency of utilization of one fuel improves more over the years than does that of another, the importance of the first will be understated as the years pass. With respect to the first qualification, the efficiency with which any one fuel is utilized varies so greatly in different combustion equipments that we are unable to make any generalization about the relative efficiencies with which the different fuels are utilized, but with respect to the second qualification we would point out that the efficiency with which coal is utilized has increased considerably since 1926. The main Canadian railways, for example, report reductions over the period covered by the chart of 12.5 per cent and 18.5 per cent in the pounds of coal burned by locomotives per gross ton mile of freight handled. Improvements in the utilization of coal have not been restricted to the railways, although they have been outstanding there. To what extent the efficiency of coal utilization has increased relative to that of other fuels is difficult to say, but the relative increase has probably been significant. Since this change has been ignored in the preparation of the chart, the chart probably exaggerates the decline in the relative importance of coal as a source of energy.

Although coal's importance as a source of energy may be declining rather less than the chart suggests, because of increasing efficiency in the utilization of coal, that very increase in the efficiency of utilization is restricting the market for coal. Coal producers are today faced by the necessity of either encouraging increased efficiency in the use of their product, reducing thereby the tonnage required to serve any given purpose, or running the risk of losing the business entirely to some competing source of energy. The possibilities for the more efficient use of coal are at present by no means exhausted. Therefore, even should the importance of coal as a source of energy remain constant in the future, it will probably be associated with a relative decline in the tonnage of coal necessary to provide coal's share of our total energy requirements.

In the course of enquiring into the market for coal in the various sections of Canada, it was considered necessary to attempt estimates of the importance of various sources of energy on a regional basis. Estimates were made for 1937 and for 1943 and are presented below. Further reference to these estimates is made in the chapter on Markets.

RELATIVE IMPORTANCE OF MAJOR SOURCES OF ENERGY
IN CANADA BY REGIONS
1937 AND 1943
(All figures are percentages)

—	Maritimes		Ontario and Quebec		Prairie Provinces		British Columbia	
	1937	1943	1937	1943	1937	1943	1937	1943
Water Power	10.7	8.5	33.7	37.8	12.2	11.0	33.3	37.9
Natural Gas	0.7	0.5	1.3	0.6	10.0	11.3	Nil	Nil
Petroleum—Canadian	Nil	Nil	0.1	0.1	7.7	17.5	Nil	Nil
Imported	11.3	18.8	12.1	8.9	8.1	1.5	33.3	29.4
Coal—Canadian	73.3	68.9	10.3	2.5	60.2	50.1	33.4	32.7
Imported	4.0	3.3	42.5	50.1	1.8	8.6	Nil	Nil
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
of which Canadian	84.7	77.9	45.4	41.0	90.1	89.9	66.7	70.6
Energy used in the Region as a percentage of Canadian use	10.5	9.9	65.7	67.4	15.4	15.6	8.4	7.1
Wood Fuel[1]—shown as percentage of energy from all other sources	13	....	9	....	15	....	17	....

[1] Figures on wood fuel are very rough estimates. They are based on estimates of wood fuel consump tion in 1940.

The primary concern of this Commission is, of course, with coal rather than with the other energy sources. However, since the demand for coal is basically a demand for energy which could be supplied in many cases from other sources, the demand for coal is determined jointly by the overall demand for energy and by the ability of coal to compete in the energy market. The effect of both of these influences in the years since 1926 is illustrated in Chart D. It is clear that the index of coal available for consumption (used as an index of the energy obtained from coal) rises and falls over the years with the index of energy consumption, but the year-to-year fluctuations in the former index appear to be superimposed on a general downward trend relative to energy consumption. The downward trend is the equivalent of the declining relative importance of coal shown on Chart E.

We intend to say very little about the probable trend of total energy requirements in Canada in the future. The relationship discussed in earlier paragraphs between energy used and the level of employment indicates that to forecast total energy requirements would be in effect to forecast the level of employment; to make such a forecast is far beyond the scope of this Commission. Energy requirements have declined slowly from the peak of 1944 and will probably continue to decline for a time. What will follow then we do not know. It may be that total energy requirements will fluctuate from period to period as they did from 1926 to 1939; if so, the amount of coal required will fluctuate more or less sympathetically. Such cyclical fluctuations have had and, if they continue, will have very unfortunate consequences on the Canadian coal industry, but they have unfortunate consequences to a greater or lesser extent on all other industries. The elimination of cyclical fluctuations would be of great benefit to the coal industry, but the problem of eliminating them is not peculiar to the coal industry, and the solution to that problem is not to be found by studying the coal industry.

We have, however, felt it necessary to examine the nature of the competition between coal and other sources of energy, with particular reference to the probable trends in the relative competitive strengths of coal and these alternative sources. In the following pages are presented, therefore, comments on water power, petroleum, wood fuel, natural gas, peat and atomic energy.

WATER POWER

On the basis of estimates described above, water power has provided during the last decade more than 25 per cent of the energy obtained in Canada from all sources. If the same amount and kind of energy as was obtained from water power had been obtained from coal, it is estimated that it would have required about 15 million tons of bituminous coal in 1937 and about 25 million tons in 1943. This is not to say that 15 million tons of coal in 1937 and 25 million tons of coal in 1943 were displaced by water power. Much of the industrial development in Canada has been possible only because cheap hydro-electric power has been available. Since nearly all industries use some coal even when hydro-electricity is cheap, industrial development based on cheap hydro-electric power may actually have increased the demand for coal. Water power and coal as sources of energy are, therefore, complementary as well as competitive. This point is stressed here because in most of what follows attention is directed to the competitive aspect rather than the complementary aspect of water power and coal. There are instances in which hydro-electricity has actually displaced coal, and our primary interest is in the extent to which coal requirements in the future are likely to be affected by competition from water power.

The Dominion Water and Power Bureau of the Department of Mines and Resources publishes annually an estimate by provinces of the available and developed water power in Canada. The estimate of this Bureau as at December 31, 1945, is reproduced below.

AVAILABLE AND DEVELOPED WATER POWER IN CANADA DECEMBER 31, 1945

Province	Available 24-hour power at 80 per cent efficiency		Turbine Installation h.p.
	At Ordinary Min. Flow h.p.	At Ordinary six mos. flow h.p.	
1	2	3	4
British Columbia	7,023,000	10,998,000	864,024
Alberta	390,000	1,049,500	94,997
Saskatchewan	542,000	1,082,000	90,835
Manitoba	3,309,000	5,344,500	422,825
Ontario	5,407,000	7,261,000	2,673,290
Quebec	8,459,000	13,064,000	5,848,572
New Brunswick	68,600	169,100	133,347
Nova Scotia	20,800	128,300	133,384
Prince Edward Island	3,000	5,300	2,617
Yukon and Northwest Territories	294,000	731,000	19,719
Canada	25,516,400	39,832,700	10,283,610

The Dominion Water and Power Bureau emphasizes that the figures in columns 2 and 3 of the table above are of water power resources recorded at present and are therefore minimum figures. It also stresses that, because turbine installations throughout the Dominion average 30 per cent greater than the corresponding available power figures for developed sites calculated as in column 3, the figures in column 4 should not be compared directly with those in columns 2 and 3. It is estimated that water power resources presently recorded, both developed and undeveloped, will permit of a turbine installation of more than 51,780,000 horse-power.

The development of Canada's water power resources has taken place almost entirely since 1900, at which time there was only an installed capacity of 173,323 h.p. The increase was more or less regular up until 1939. The increased power requirements of World War II stimulated the development of water power and the increase of installed capacity from December 31, 1939, to December 31, 1945, was nearly 2,000,000 h.p., distributed as follows:

Quebec	1,763,809 h.p.
British Columbia	116,011 h.p.
Ontario	76,491 h.p.
Alberta	23,000 h.p.

The increase in installed capacity in Quebec was due largely to the construction of the 1,200,000 h.p. Shipshaw plant to supply the aluminum industry.

A comparison of the developed and potential water power resources of Canada with those of other countries is possible for the year 1938 by virtue of estimates compiled by the Geological Survey of the United States Department of the Interior. These estimates indicate that in 1938 Canada's total developed water power was exceeded only by that of the United States and that in per capita installation Canada was surpassed only by Norway and Newfoundland. In potential power Canada is shown as fifth among the countries listed (with

the U.S.S.R., India and Ceylon, Brazil and the United States leading), but if account be taken of the availability of power resources to existing markets, it is believed that Canada is outranked only by the United States in potential resources.

As at December 31, 1945, about 90 per cent of the turbine capacity installed in Canada was in central electric stations, with two-thirds of the remainder being in pulp and paper mills and the other one-third in other industries.* The hydraulic installations are used almost entirely for the generation of electricity. There are instances in which turbines are connected by mechanical coupling to machines other than generators but they are few in number and not important. The concentration of water power resources on the generation of electricity was in many cases a condition of their development, for many of them are some miles removed from the areas which require the energy they develop, and only in the form of electricity is the transmission of that energy feasible. Without relatively long-distance transmission important power sites, such as those on the Bow River in Alberta, on the Winnipeg River in Manitoba and on the St. Maurice River in Quebec, would be of relatively little value. At the present time 200 to 250 miles is the practical limit for electricity transmission in Canada; transmissions beyond that range are possible but only at sharply increasing costs per mile. This consideration is of first-rate importance in assessing the prospects for future development of Canada's vast undeveloped water power resources. A very considerable portion of these resources are located at points well outside the present workable transmission range of the main energy-using areas. The enormous resources on the Nelson River in Manitoba, and on a number of rivers running westward into James Bay, are examples of potential water power sites which are at present too far removed to be of immediate value. Until there are either substantial improvements in transmission techniques or very large shifts of industry in the appropriate directions, this situation will continue. It follows, therefore, that the figures of potential water power resources given above vastly exaggerate the water power development that will in the immediate future be practicable.

Not only is almost all hydraulic equipment in Canada used to generate electricity but also almost all of the electricity generated in Canada is produced by hydraulic equipment. Over the past ten years almost exactly 98 per cent of the output of the central electric station industry has been hydraulically generated. A comparable figure for other generating stations is not available but, although a few fairly large thermal generating stations are known to be among them, it is believed that most of the power generated by these stations is also generated hydraulically. Therefore, it is estimated that well over 90 per cent, and probably over 97 per cent, of the electricity produced in Canada is generated from water power.

It must be emphasized here that the generalization that electricity in Canada is produced almost entirely by water power is not true for all areas in the country. In Saskatchewan, for example, while there are two hydraulic stations in the Province, almost all of the electricity output is fuel generated. In Alberta and in the Maritimes an appreciable proportion of the electricity produced is fuel generated. Nevertheless, the tremendous over-all preponderance of hydraulic

* As defined for census purposes, central electric stations are companies, municipalities or individuals selling or distributing electric energy, whether generated by themselves or purchased for resale. Many of the stations owned and operated by industries and producing electricity for their own use fall within this definition.

generation in Canada is a very distinguishing feature of our electricity production. It contrasts sharply with the situation in the United States, where over the last decade only slightly more than one-third of the electricity produced by all plants contributing to the public supply was hydraulically generated.

The geographical distribution of water power development in Canada may be summarized briefly as follows: as far as power generation is concerned, the only important river system in the Maritimes is that of the St. John, on which there are a number of developed sites, particularly in the vicinity of Grand Falls. Throughout each of the Maritime Provinces there are a considerable number of small hydraulic stations on smaller rivers. In Ontario and Quebec the main power plants are located on the rivers making up the St. Lawrence drainage system. There are large hydraulic installations in the vicinity of Niagara Falls, on the upper tributaries of the Ottawa River, particularly on the Montreal River and the Quinze River, in the vicinity of the City of Ottawa on the Ottawa River itself and on its tributaries, the Madawaska, the Gatineau and the Lievre Rivers, on the St. Lawrence River near Montreal, at various points on the St. Maurice River and on the Saguenay River near Lake St. John. There are also large installations on numerous rivers, particularly the Nipigon, draining into Lake Superior and on the Abitibi and Mattagami Rivers draining into James Bay. In addition, and particularly in southwestern Ontario, there are a great many smaller installations on a number of smaller rivers. In the Prairie Provinces developed hydraulic sites are largely restricted to the Winnipeg River east of Winnipeg, to the Churchill River near the Saskatchewan-Manitoba border, and to the Bow River west of Calgary. In British Columbia the most important installations are on the Kootenay River near Nelson, on the Stave River near Vancouver, and on the North Arm of Burrard Inlet fed from Coquitlam Lake.

Use of Electricity in Canada

On the following page is presented a table, based on figures published by the Dominion Bureau of Statistics, of the use of electricity in Canada in 1939 and 1943. From the material in that table and the additional fact that about 90 per cent of the electricity used by the manufacturing and mining industries is purchased from central electric stations, it is estimated that of the electricity used in Canada roughly one-third is used by the manufacturing and mining industries for power, and a second third by the manufacturing industries for purposes other than power and light.

By 1943 just over 80 per cent of the power equipment installed in the manufacturing and mining industries in Canada was electrically driven. For many years there has been a steady trend toward electric drive. This trend has undoubtedly been encouraged by the availability of cheap hydro-electric power in many parts of Canada, but it cannot be explained entirely by that circumstance. In the United States, where about two-thirds of the electricity produced in recent years has been thermally generated, the trend toward electrification has also been pronounced. The convenience and efficiency of distributing power in the form of electricity is so great that it is being more and more widely used regardless of the source of the energy. The significance of this trend to the coal industry lies in the fact that the prospects of coal supplying the power needs of industry depend very largely upon coal's ability to compete with other energy sources in the generation of electricity.

USE OF ELECTRICITY IN CANADA 1939 AND 1943

Industries	1939			1943		
	Electricity Used (including own generation)		Per cent of the power purchased from central electric stations used for other than power and light	Electricity Used (including own generation)		Per cent of the power purchased from central electric stations used for other than power and light
	In millions of kilowatt-hours	As per cent of total electricity used		In millions of kilowatt-hours	As per cent of total electricity used	
Manufacturing Industries	19,430	62.7	55	29,611	67.4	60
of which Pulp and Paper	11,085	35.8	55	8,039	18.3	25
Primary Iron and Steel	529	1.7	55	2,017	4.6	76
Non-ferrous Smelting and Refining	3,493	11.3	78	11,280	25.7	92
Non-metallic Mineral Products	676	2.2	56	1,641	3.7	73
Acids, Alkalies and Salts	1,000	3.2	89	1,881	4.3	73
Mining Industries	1,761	5.7	1	1,895	4.3	1
of which Metal Mining	1,418	4.6	1	1,474	3.4	1
Other Industries	1,235	3.9	....	2,073	4.7	....
Domestic Service (Residential)	2,311	7.5	....	2,844	6.5	....
Commercial Lighting	1,109	3.6	....	1,261	2.9	....
Street Lighting	204	.7	....	193	.4	....
Free Service (other than street lighting)	17	.1	....	67	.1	....
Exports to U.S.A. (net)	1,908	6.1	....	2,544	5.8	....
Losses	2,993	9.7	....	3,451	7.9	....
Total	30,970	100.0		43,940	100.0	

The use of electricity by the manufacturing industries for purposes other than power and light include its use for steam generation, for other process heating, and for electrolytic processes. The last use is the smallest; although a number of non-ferrous metals are refined and various chemical compounds produced electrolytically, the amount of electricity used does not constitute an appreciable portion of the total.

The use of electricity for steam generation accounted for about three-quarters in 1939 and one-eighth in 1943 of the electricity used for "other purposes". The principal user for steam raising was the pulp and paper industry, although substantial amounts were used before the war by the aluminum industry and lesser amounts by various other industries. There is no technical reason for using electricity for steam raising; it is used only when steam can be generated more cheaply from it than from coal. The amount of coal displaced by electric steam generation is so considerable that a fuller discussion of this use of electricity will follow later.

The largest user of electricity for other process heating is the aluminum industry. Electricity is used in that industry for the reduction of alumina (Al_2O_3) to aluminum. The process requires 9 to 10 kilowatt-hours per pound of aluminum produced. The process of reduction is actually an electrolytic one, although it has never been carried on successfully on a commercial scale except by the use of heat from electricity to provide and maintain the molten cryolite bath in which the process is carried on. Another substantial user of heat from electricity is the primary iron and steel industry. In that industry there is an increasing use made of electric furnaces for the production of both steel and steel alloys. The rated annual capacity of electric furnaces in the iron and steel industry very nearly tripled for the years from 1939 to 1943. Additional large quantities of electricity are used for heating purposes in the manufacture of fused alumina and silicon carbide abrasives. Finally, various chemical compounds, particularly calcium carbide and calcium cyanamid, are produced with the aid of large quantities of heat obtained from electricity.

Except for electric steam generation, the use of electricity by industry for "other purposes" is explained by the technical advantages that result from its use. Most of the electricity so used is used to produce heat and, generally speaking, the higher the temperature required and the more important temperature control the greater is the advantage of using electricity rather than coal or coke. Normally coal is a much stronger competitor with water power in the production of heat than it is in the production of power (for reasons explained later). It is, therefore, somewhat surprising to discover how extensively water power is used to provide industrial heat. It appears that in most cases coal would be used to provide this heat only if it were a cheaper source of electricity.

The conclusion suggested by this brief survey of the uses made of electricity in Canada is that, except for the generation of steam by electricity, the supply of energy in the electrical form has so many advantages that there is little chance for coal to compete directly. The prospects for coal capturing any of the energy market at present served by water power depend largely upon its ability to compete with water power in the production of electricity.

Coal versus Water Power for the Generation of Electricity

It is quite impossible to generalize about the relative costs of generating electricity from coal and from water power. In any given situation a competent engineer can determine which source will be the cheaper, but his conclusions will have no necessary validity for any other situation. There are, however, a number of considerations which must be taken into account in any determination

of the cost of producing electricity from alternative sources. Some comment on these considerations may help to explain the nature of the competition between them.

The capital cost per horse-power and therefore the annual interest charge is usually appreciably greater for a hydro installation than for a steam one. The capital cost of developing any given water power site depends largely on the physical characteristics of that site—on the topography, the stream flow, the accessibility of the site, etc. The major outlay is likely to be on the engineering tasks necessary to prepare the site—building dams and retaining walls, flumes or penstocks, dredging a tail-race channel, developing water storage facilities and flow control, etc. In comparison, the cost of the generating equipment and of the buildings to house it may be relatively small. For this reason it is rarely economical to develop only a part of the power of a site. The amount of energy that a given water power site can be made to produce is dependent on the head and on the water supply available, but once the site is developed the total cost of producing energy is practically independent of the amount of energy produced. It follows from this that, as the amount of energy produced by a hydro installation increases, the cost per unit of the energy declines steadily.

Very little improvement of the site is usually necessary for a steam plant. The principal initial outlay is for equipment and for the buildings to house it. This outlay varies more or less directly with the capacity of the plant and one is allowed, therefore, much more latitude in respect of capacity in erecting a steam plant than in developing a water power site. Once a steam plant is built considerable additional costs are involved in operating it, the main one being for fuel. Under Canadian operating conditions, a fuel cost per unit of output amounting to one-half of total cost per unit of output would not be unusual. The cost per unit of output of a steam plant will not, therefore, decline nearly so rapidly with an increase in output.

The way to obtain the lowest cost of unit per output with either type of plant is to operate continuously at capacity but this is rarely possible. The output of a hydro plant is limited by the amount of water available, which normally varies seasonally and annually. The demand for electricity fluctuates daily and seasonally and, since electricity cannot be stored economically, it must be generated when it is wanted.

The different relationship between unit cost and output for steam and water plants, the variations in stream flow, and the necessity of meeting a fluctuating demand for electricity, sometimes permit steam to be used in conjunction with hydro even where hydro resources are abundant. There are a number of ways in which plants may be integrated. In some cases, and particularly during the wetter seasons, it is advantageous to have hydro stations operate as near to capacity as possible, using steam only for peak periods, if at all; in the dry seasons, then, the situation may be reversed, with steam carrying the base load and the limited water used to meet the peaks. In other cases, where storage facilities are fairly good, any over-all shortage of water can be made up by using steam at any time convenient. In this way, off-peak power of a steam system can be used; this is what is, on occasion, done in Alberta. Where a hydro system has some storage facilities, the addition of a steam unit may actually increase the hydro output by allowing an increase in the range through which water storage may be drawn down without running the risk of being short of power before more water becomes available. The number of possible combinations is great, and the choice of the best one can be made only by competent persons familiar with the details of any particular situation. The important point is that, even where hydro resources are abundant, the use of steam is not necessarily precluded; there is always a possibility of the two methods being able to supplement each other economically. This possibility is important, for in the Maritimes, Central Canada and Alberta it offers the best prospect for coal insofar as the generation of electricity is concerned.

The cost of delivered electricity includes the cost of generation plus the costs of transmission and distribution. These latter costs are a much larger fraction of total cost than is generally appreciated; they may, in fact, far exceed the cost of generation. Normally, hydro plants are not as near the centre of load as are steam plants and the transmission costs for hydro plants are, therefore, usually greater. It is the total cost of delivered electricity which must be considered when determining whether to use steam or water power and thus the farther the power site is from the centre of load the more competitive will coal be.

To generate electricity, mechanical energy is needed to drive the generators. If coal is to supply the energy, the heat energy liberated from coal by combustion must be converted into mechanical energy. This conversion is effected in engines designed for the purpose, the common examples of which are steam reciprocating engines and steam turbines. An important characteristic of these heat engines is that there is both a theoretical and practical limit to their efficiencies, and these limits are relatively low. Of the useful sensible heat obtained from coal rather less than half can be converted into mechanical energy by the most efficient equipment available; the rest of the heat is lost. Heat is lost in various ways, but the most important loss arises from the fact that the latent heat absorbed by the water in its conversion to steam cannot be utilized in the heat engine, and is lost in the process of condensing the exhaust steam for return to the boiler. In the coal to kilowatts cycle there will be, in addition to the heat engine losses, combustion losses in developing heat from the coal at one end and generator losses in converting the mechanical energy at the other. Since combustion efficiencies of 87 per cent and generator efficiencies of over 95 per cent are not unusual, these losses are much smaller than those unavoidable in the heat engine. Total losses in the coal to kilowatt cycle, using the most efficient (steam turbine) equipment available, amount to very nearly two-thirds of the potential heat of the coal used. The most efficient conversion achieved at present in the United States is about 10,000 B.t.u. of potential heat in coal to one net kilowatt-hour and, since a kilowatt-hour is 3,415 B.t.u., the overall thermal efficiency of the equipment is 34 per cent. Experiments have been carried on with equipment using mercury vapour, for which, before the war, thermal efficiencies of about 37 per cent were expected. Engineers working on a closed cycle gas turbine have recently claimed performances superior to the conventional steam turbine. Future improvements in thermal efficiency are therefore likely, but progress appears to be slow.

In contrast with the best performance attainable, most installed equipment is much less efficient. The average of all fuel stations contributing to public supply in the United States in 1945 was 1.31 pounds of coal (or its equivalent) per kilowatt-hour, which, assuming 13,000 B.t.u. per pound coal, works out to a thermal efficiency of about 20 per cent. Operating statistics are not readily available for many Canadian plants, but tests run under steady load in the 12,500 kilowatt steam-electric station of the Nova Scotia Light and Power Company Limited, built in Halifax in 1944, indicated a consumption of about 13,700 B.t.u. per net kilowatt-hour, or an overall thermal efficiency of about 25 per cent. Among Canadian plants this is undoubtedly one of the most efficient.

One interesting consequence of the losses involved in the coal to kilowatt cycle is that coal is much less competitive with water power in the production of power than it is in the production of heat. If coal is used to generate electricity and the electricity is used for heating purposes less than one-quarter of the potential heat of the coal will normally be recovered. If, on the other hand, the heat from coal is used directly, something more than 80 per cent of the potential heat of the coal may be utilized.

A second interesting consequence of the losses normally associated with the coal to kilowatt cycle is that, if there exists a demand for a considerable amount of medium or low pressure steam, the more serious losses involved in thermal generation of electricity may be avoided. Where steam would have been raised in any event it can be raised at a somewhat higher pressure than would otherwise have been done and fed through turbines before it is used for heating purposes. The loss of heat in condensers, which normally serves no useful purposes, is here avoided for the steam exhausted from the turbines is used for, and properly chargeable to, those operations for which it would have been raised in any event. The drop in temperature of the steam in passing through the turbines must be offset by increasing the steam temperature in the boilers, but additional heat added can, under these circumstances, be converted into mechanical energy with high efficiency. The electricity made available is a sort of by-product and may cost less than one-half as much as that generated by means of condensing turbines. Such by-product generation is limited to situations where the demand for steam for heating purposes is both large and steady. It so happens that in Canada at present most of the steam demand of that type has been met by the use of hydro-electric boilers. As long as this situation continues the prospects of the kind of by-product electricity generation here described from coal will be very limited.

It is beyond the scope of this report to investigate the advantages and disadvantages of hydro and steam generation in all of the numerous areas in Canada where electricity is generated. It has already been indicated that possibly as much as 97 per cent of the electricity produced in Canada is generated from water power. The importance of thermal generation is, however, quite considerable in some provinces. In 1939, for example, thermal generation accounted for nearly 100 per cent of the central electric station output in Saskatchewan, 97 per cent in Prince Edward Island, 42 per cent in Alberta, 32 per cent in Nova Scotia and 12 per cent in New Brunswick. For most of the thermal generation, coal was the fuel used. Coal consumption in central electric stations in that year amounted to 450,000 tons. Within the field of thermal generation, however, coal met stiff competition from petroleum products. For small generating stations in more or less isolated communities, the diesel engine is much more satisfactory than the steam engine for electricity generation. There are in Canada nearly 500 gas and oil engines, with an average capacity of under 90 h.p., in use in central electric stations. The fuel consumption of these engines was the equivalent of about 50,000 tons of coal in 1939.

Use of Electricity for Steam Raising

The generation of steam from electricity is cheaper than from coal only when electricity is very cheap relative to coal. Before the war the price paid for electricity for this purpose was about one mill per kilowatt-hour. Some producers now contend that, with the increased price of coal, electricity is worth 1.4 mills per kilowatt-hour for steam raising. Whichever figure one takes, the fact remains that such prices are far below the total cost of generating electricity hydraulically. But they do exceed hydro operating costs, and for that reason such sales are profitable to the producers providing that the generating capacity has already been installed and that there is no other market. The power thus sold is surplus power and is called secondary power. In order to maintain his freedom to meet demands for other purposes for which a higher price will be paid, the producer normally retains the right to cut off surplus power users at his

discretion. The supply of secondary power is thus not usually guaranteed, which distinguishes it from primary power, which is guaranteed. As a rule primary power is not sold at a price below the sum of the fixed and operating costs involved in its generation. That price may, in Canada, be anywhere from about $12.00 per h.p. per year up, depending upon the area, the load factor,[1] the point of delivery, etc. Since even the 1.4 mills per kilowatt-hour mentioned above is the equivalent at an 86 per cent load factor of less than $8.00 per h.p. per year[2], it is clear that primary power could not normally be used for electric steam generation.

The availability of secondary power depends on surplus generating capacity. The surplus capacity of any given hydro plant will be, at any one moment, the difference between the plant's primary load and the output which, with due regard to the water available, the operator feels free to attain. Because of the necessity of conserving sufficient water to safeguard the primary load, the amount of secondary power which is available will usually vary from wet to dry seasons and from wet to dry years. In addition, the ability to provide secondary power will vary inversely with the primary load. If peak primary demands in a system do not approach the available output, secondary power may be available continuously, as it is at present in the Lake Saint John area. If peak primary demands do approach the available output, secondary power will necessarily be intermittent. This has been the situation in the Montreal area, where secondary power users have been cut off for a short period each week-day afternoon.

Surplus generating capacity and enough water to run it are not the only requirements for secondary power sales. There must be surplus transmission capacity as well. It has been emphasized that the original cost of transmission systems is great and, therefore, if the full cost of transmission were to be charged to secondary power, the total cost of that power in plants other than those in the immediate vicinity of the supplying station would exceed its value for steam raising.

The only important use of secondary power in Canada is for steam raising. For this purpose, an electric boiler is used. It is believed that all of the electric boilers used in Canada are of the water-resistance type, in which electrodes are submerged in water and heat is generated by the passage of current between the electrodes, the water itself forming the resistance. They vary in size, the largest so far installed being of 37,500 kilowatt capacity. They produce saturated steam at pressures up to 275 pounds per square inch. The overall thermal efficiency of these electric boilers is very high, being of the order of 95 per cent. If one assumes a thermal efficiency of about 82 per cent (which is fairly high) for a coal-fired boiler and 95 per cent for an electric boiler, then one ton of 13,000 B.t.u. per

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[1] Load factor is the average load (or demand) as a percentage of the maximum load.

[2] Energy Equivalents

Kilowatt-Hour	Horsepower-hour	B.t.u.
1	1.341	3,415
0.7457	1	2,545

pound coal is the equivalent, for steam raising purposes, of about 6,550 kwh*. On this basis, the coal equivalent of secondary power used in Canada has been estimated for the years 1934-1945 inclusive and is shown below.

ESTIMATED COAL EQUIVALENT IN TONS OF SECONDARY POWER USED IN CANADA[1]

—	Canada[2]	New Brunswick	Quebec	Ontario	Manitoba
1934	851,000	7,000	596,000	212,000	36,000
1935	1,014,000	4,000	700,000	262,000	47,000
1936	1,113,000	7,000	813,000	225,000	66,000
1937	1,191,000	6,000	883,000	228,000	73,000
1938	936,000	12,000	650,000	206,000	67,000
1939	1,074,000	8,000	729,000	264,000	73,000
1940	828,000	3,000	556,000	212,000	56,000
1941	516,000	5,000	297,000	144,000	69,000
1942	342,000	4,000	134,000	126,000	78,000
1943	323,000	2,000	115,000	122,000	83,000
1944	419,000	2,000	193,000	148,000	75,000
1945	848,000	2,000	606,000	157,000	83,000

[1] Based on Dominion Bureau of Statistics figures of secondary power consumption in Canada and converted at 6,550 kwh. equal 1 ton.

[2] Includes small amounts used in other provinces.

It is estimated that by the end of 1946 the following electric steam generators (boilers) will have been installed in Canada:

—	Number of Generators	Kilowatt Capacity	Percentage of Total Capacity Installed
Quebec	91	1,303,700	75.6
Ontario	28	264,250	15.3
Manitoba	39	88,750	5.2
British Columbia	9	46,000	2.7
New Brunswick	4	21,500	1.2
Yukon	1	500	....
Canada	172	1,724,700	100.0

It is not known how many of the above generators are, or will be, in use. Some of them are probably unusable. But the life of an electric steam generator is usually a long one, and so almost all of the total capacity that has been installed can be considered as a potential outlet for secondary power. Collectively they could absorb the output of some 2,300,000 h.p. of generating capacity, and, if their load factor averaged 75 per cent, they could consume over 11,000,000,000 kwh. of electricity per year, or the equivalent of about 1.7 million tons of bituminous coal. These figures are given to indicate the size of the market that exists for secondary power. They are not to be interpreted as an estimate of the extent to which that market will be supplied.

Of the total capacity installed, 1,382,900 kw. or about 80 per cent is estimated to be installed in the pulp and paper industry. In that industry they are used to provide the enormous quantities of steam needed in digesters and for drying paper, as well as for space heating. The remaining 341,800 kw. capacity has been installed for a variety of uses. Some 128,000 kw. capacity has been installed in various plants of the Aluminum Company of Canada, primarily to provide steam for the earlier stages of bauxite refining, but also for space

6,550 kwh. is also the equivalent of one horse-power year (at 100 per cent load factor.)

heating. Approximately 45,000 kw. capacity has been installed in Winnipeg, chiefly to supplement steam boilers in generating steam for district heating purposes. A further 43,000 kw. capacity is installed in textile mills, and about the same in metal smelting, refining and fabricating plants. The remainder is installed mainly for use in chemicals, rubber goods and brewery products manufacturing and for space heating.

There are certain advantages of electric steam generators over and above their ability to use cheap secondary power. Compared with coal-fired boilers they are very simple in construction, they save on operating labour, and they are completely clean. But they also have disadvantages. They are much smaller per unit of capacity than is coal-burning equipment but, because the supply of secondary power is not guaranteed, fuel-burning equipment must normally be installed anyway, and so electric steam generation uses rather than saves space. They are not readily adjusted to take care of quick variations of load. Steam accumulators have been used with them, but they add to the initial capital outlay. The fact that they produce saturated steam is claimed to be a disadvantage by some pulp and paper users, largely on the grounds that saturated steam increases the dilution of acid in sulphite pulp digesters and thus increases sulphur consumption.

The greatest wartime increase in hydro generating capacity was in the Saguenay district of Quebec. To provide electricity for aluminum production, a 1,200,000 h.p. development, called the Shipshaw Plant, was built on the Saguenay River. With that addition, the hydro installations on the Saguenay River, all owned and operated by the Aluminum Company of Canada or its subsidiaries, total 2,040,000 h.p. Aluminum Company engineers estimate that, after allowance for variation in stream flow, they will have on the average 1,500,000 effective h.p. During the war aluminum output absorbed practically all of the power available in the Saguenay district and primary power was brought into the area to meet the requirements of other users. Since the end of the war the decline in aluminum output has freed a substantial amount of power for other purposes. During the summer of 1946 about 600,000 h.p. was being used to provide secondary power for paper mills in the Lake Saint John and Quebec City areas, and for the aluminum plant. Assuming that 1 horsepower-year is the equivalent of 0.9 tons of bituminous coal*, secondary power generated in the Saguenay district is currently displacing about 540,000 tons of coal per year. The primary demand for aluminum production may rise to a million horse-power within a year. If this happens, the supply of secondary power in the Saguenay district may be somewhat curtailed.

During the war years the Shawinigan Water and Power Company made two additions to its capacity, 225,000 h.p. on the St. Maurice River at La Tuque, and 40,000 h.p. on the same river at Rapide Blanc. During the immediate pre-war years, the Shawinigan Water and Power Company generated about 1,500 million kwh. per year of secondary power in addition to its purchases (mostly from the Saguenay Plants) for resale as such. At that time the Company was the largest supplier of secondary power in Quebec. During the war there was very little surplus capacity in the system, but now that the war is over the Company has again been selling about as much secondary power as pre-war. Should such sales continue, they will be the equivalent of over 200,000 tons of coal annually.

The Quebec Hydro-Electric Commission expects that sales of secondary power from its system will not increase substantially over the pre-war rate despite the wartime addition of 212,000 h.p. to the Beauharnois Plant. The sales

* The coal equivalent of 1 horsepower-year has been variously estimated at from 0.8 to 1 ton of 13,000 B.t.u. coal. The estimate one arrives at depends largely upon the load factor used. One horsepower-year at 100 per cent load factor is the approximate equivalent of 1 ton of coal. Paper mills in the Saguenay area have recently been operating at a 24-hour day, 6-day week; under such conditions, their load factor would appear to be about 86 per cent. The conversion ratio, 1 horsepower-year = 0.9 tons of coal, seems, therefore, to be reasonable for our purpose.

of secondary power by that system totalled 352,000,000 kwh. in 1939, or the equivalent of over 50,000 tons of coal. Even though the Montreal district has some 10 to 15 per cent surplus generating capacity in the summer months, there is not the surplus transmission capacity available to distribute secondary power to potential metropolitan users.

In the pre-war years the Gatineau Power Company sold on the average about 650,000,000 kwh. of secondary power annually. Most of it was used by the Gatineau Mill of the Canadian International Paper Company for steam raising. In the future, the Gatineau Power Company expects to deliver more power to the Ontario Hydro-Electric Power Commission than it did in the pre-war years, and its annual secondary power sales are expected to be in the neighbourhood of 300,000,000 kwh, or the equivalent of about 45,000 tons of coal.

During 1946 there appears to have been about as much secondary power used in the Province of Quebec as in any pre-war year with a displacement of more than 750,000 tons of coal. The amount of coal that will be displaced in future years depends upon the demand that there may be for primary power. Over a period of years primary demand will undoubtedly grow but for the next few years very appreciable tonnages of coal will continue to be displaced by the use of secondary power for steam generation.

In comparison with Quebec, secondary power consumption in Ontario is small. For years the problem of the Hydro-Electric Power Commission of Ontario has been to expand its generating capacity at a rate adequate to meet its growing primary load, and therefore such surplus capacity as it may have from time to time is of the intermittent off-peak type. Moreover, the United States provides a more profitable market for much of the surplus power available in the Niagara Falls area. For these reasons, the use of hydro electricity for steam raising is not likely to exceed by much the 1945 total of one thousand million kilowatt-hours (about 150,000 tons of coal).

There is no reason to expect any increase in the use of secondary power in Manitoba. The consumption of secondary power has been fairly constant at about 500,000,000 kwh. per year for several years and no changes in either generating capacity or primary load great enough to affect secondary power consumption are anticipated. In the other provinces of Canada no appreciable use of secondary power is foreseen.

Space Heating by Primary Power

The use of primary power for space heating is at present very limited. Small electric heaters in domestic establishments are, of course, common, but the proportion of the total heat which is obtained from them is usually very small. In some Canadian cities there are houses heated entirely by electricity, but so far there are not many. Because of the convenience of electricity for space heating it is interesting to examine the chances of hydro electricity capturing the space heating market.

There are three characteristics of the space heating market that reduce the competitive strength of hydro in it. The first of these is that, because it is a heat market, hydro's initial competitive strength is less than it would be in a mechanical energy market. The losses inevitable in the conversion of heat energy to mechanical energy, which reduce the ability of fuels to provide mechanical energy cheaply, are avoided in this market. The second characteristic is that the supply of heat for space heating purposes must be continuous over the months in which it is required. Since secondary power is a product of surplus capacity, secondary power would be satisfactory for space heating only where the necessary surplus capacity existed continuously over the period when heat was required. Such a situation would be unusual. The space heating load of office

buildings, domestic establishments, etc. would far exceed the load for any other purpose, and, if electric space heating were widely practised, present transmission and distribution capacity would be quite inadequate. This is particularly true in that the space heating peaks, both seasonal and daily, would tend to coincide with the same peaks for all other purposes. Since the daily load factor of most potential space heating customers is at present fairly low, there is at present intermittent surplus capacity, but most of those potential customers would consider intermittent heat most unsatisfactory. The opportunities, therefore, of using secondary power for space heating are seriously limited. If electric space heating is to be widely used, there will have to be a substantial investment made in transmission and, in most areas, in generating capacity. Most of the electricity so used would in effect be primary power, and would have to be paid for at primary power rates. The third characteristic unfavourable to hydro of the space heating market is that it is a seasonal market. The annual load factor for a space heating load is usually estimated at from 30 to 35 per cent. It has already been emphasized that the cost per unit output of a hydro system varies more or less inversely with the system's output. A load where average output is so far below capacity means a relatively high average cost per kilowatt hour and, therefore, relatively high cost heating. The seasonal nature of the space heating demand has the result, therefore, of increasing substantially the cost of space heating by electricity.

No attempt has been made to estimate what the relative cost of space heating by hydro electricity and by coal would be for any particular area. However, assuming that electricity could be delivered for $20 per h.p. per annum (which is cheaper than it is delivered for power in most parts of Ontario) and that the space heating load factor was 35 per cent, the cost per kilowatt-hour would be about 8.7 mills. Assuming further that the thermal efficiency of electric heating is 95 per cent and that of coal heating is 70 per cent, the equivalent cost of anthracite coal (13,600 B.t.u. per pound) would be about $51 per ton. Since these assumptions are collectively more favourable to hydro than appears to be typical, it does seem that, even after full allowance for the convenience of electricity, space heating by primary power is not competitive with coal.

One development that may somewhat alter this situation in the future is that of the "reversed refrigeration cycle" method of space heating. Just as the refrigeration plant of the ordinary electric refrigerator extracts heat from the refrigerator cabinet and dissipates it in the surrounding air, so the same kind of plant can be used to extract heat from the outside air and transfer it to the inside of a building. Because the purpose of such equipment is to transfer heat from one place to another, it is called a "heat pump". The advantages of the heat pump arise from the fact that the heat it can be made to deliver far exceeds the equivalent of the electric input necessary to make it operate. Under favourable conditions, the ratio of heat output to heat equivalent of the electric input, known as the coefficient of performance, may be more than four; there are reports of installations in use in the United States giving coefficients of performance greater than 3. Such performance is possible because the electricity used is not used to generate heat but rather to move heat from one place to another. The result is to reduce substantially the amount of electricity needed to make available any given quantity of heat. The value of electricity for space heating, and consequently, the price that can be paid for it, rises accordingly. There is, in addition, the advantage that the same equipment can be used to pump heat from inside to outside during hot weather.

Probably the most serious limitation of the heat pump, insofar as its application to Canadian conditions is concerned, is that the coefficient of performance falls as the difference between inside and outside temperature increases. According to estimates presented before the American Institute of Electrical Engineers

in June, 1944, the coefficient of performance for an inside temperature of 70° F. drops from about 4 at an outside temperature of 55° to just over 2 at 0° F. Thus, just when the demand for heat is greatest the performance of the heat pump is poorest. But that is not all. When the outdoor temperature falls to or below freezing there are serious difficulties encountered. Air-served evaporators plug with frost, and, while an ample and low-cost supply of not-too-cold water would be an excellent alternative heat source, it is rarely available. The problem of finding a suitable heat source for cold weather operation is one that must be solved before the heat pump can make much of a contribution to Canadian space heating needs.

PETROLEUM

Petroleum ranks third among the sources of energy used in Canada. In the immediate pre-war years and during the war it provided roughly one-seventh of the energy obtained from all sources. In recent years it has been about one-half as large a contributor to our energy requirements as water power and about one-third as large a contributor as coal. In the United States about one-third of the energy obtained from all sources in the pre-war years came from petroleum.

The relative importance of petroleum as a source of energy in Canada appears to have grown over the past two decades. The evidence of the estimates in this respect is supported by comments of coal men from coast to coast. In both this country and the United States coal producers have experienced increasingly intense competition from liquid fuel. The extent to which that competition may continue in the future is difficult to estimate, but it is of real concern to the coal industry. The purpose of this section is to examine rather briefly the extent to which, and the purposes for which, petroleum is used in Canada, where it comes from, and what the considerations are which are most likely to affect its competitive position relative to coal in the near future.

The Use of Petroleum Products in Canada

There are very many petroleum products, but fortunately we need to deal with only the few that are of greatest importance. The nomenclature and specifications for these few vary considerably, but they include gasoline, kerosene, light fuel oils or distillates (including diesel fuel, stove oil, furnace oil, etc.), heavy fuel oils (sometimes called bunker fuel oil, industrial fuel oil, residual fuel oil, etc.), and petroleum coke. Within each group there are a varying number of commercial grades or qualities, each differing from the others in specific gravity, volatility, viscosity and other respects. All of them are hydrocarbons, all of them are obtained from crude petroleum, and all of them, except petroleum coke, are liquids at normal temperature. The liquid hydrocarbons are usually classified according to their specific gravity, the gasoline range being the lightest and the heavy fuel oil range the heaviest*.

For some petroleum products no satisfactory substitutes are available. The development of the internal combustion engine burning gasoline or distillate has provided a light mobile power unit which has revolutionized transportation and, while it is not impossible, it is difficult to supply the energy required from any other source. The internal combustion engine is also a very satisfactory source of stationary power wherever power requirements are relatively small, or are intermittent, or occur in places difficult of access, and where hydro-electricity is not available. Thus diesel engines are widely used in some mining operations and in small plants generating electricity.

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* The specific gravity of any grade may be expressed in the normal way, (that is, its weight relative to that of water as 1), or it may be stated according to a standard established by the American Petroleum Institute, called the A.P.I. gravity. This scale expresses specific gravity as so many degrees, the number of degrees increasing as the specific gravity decreases.

For the greater part, the use of petroleum fuels in internal combustion engines is only indirectly competitive with coal. To the extent that road transport reduces the ton-miles or passenger-miles operated by the railways, the demand of the railways for coal is reduced, but coal could not supply directly the energy required by light mobile power units. However, as the size of the petroleum-fed engine increases the competition it offers to coal becomes more direct. In the transportation field the use of diesel locomotives is seen by the American coal producers as a serious invasion of their market. In the case of stationary diesel engines coal is always a practicable alternative even though, particularly for small power requirements, its competitive strength is weak. In general, however, the power demand met at present in Canada by internal combustion engines and for which coal is even a remotely practical alternative, is too small to be of much consequence to the coal industry.

Aside from the provision of power directly petroleum products are used to produce heat. For this purpose the heavier fractions, ranging from lighter furnace oils to residual fuel oil, are used. In some cases the heat is used to raise steam for power purposes, in others for processing purposes, and in others for space heating. As a rough estimate, these three uses of petroleum accounted for 40 per cent of the petroleum consumed in Canada in the pre-war years. At that time the coal equivalent of petroleum products so used was approaching 4,000,000 tons annually; during the war it rose to well over 5,000,000. The size of the heat market supplied by petroleum is thus large enough to be of consequence to the coal industry.

In the table below are presented figures in millions of Imperial gallons of petroleum fuel delivered for various purposes.

USE IN CANADA OF THE HEAVIER PETROLEUM FUELS*

(In millions of Imperial gallons)

Year	Delivered for Domestic and Building Heating	Delivered for Industrial Heating and for Power	Delivered to Railways	Delivered for Bunkering	Total
1933	100	81	43	129	353
1935	109	115	47	137	408
1937	118	158	53	161	490
1939	136	173	54	205	568
1941	147	290	73	275	785
1943	95	313	78	234	720

*Excluding all deliveries of gasoline and kerosene and excluding deliveries of distillate and fuel oil for use in motor vehicles and central electric stations.

SOURCE: Department of Mines and Resources, Pamphlets No. 808 and No. 814.

To permit the reader to obtain a rough idea of what these figures mean in terms of coal, it is suggested that one million gallons (1 unit in the table above) is the equivalent in heat value of about 7,000 tons of bituminous coal.

There was a steady increase in the use of oil for domestic and building heating throughout the 1930's and into the war years until wartime shortages required the Oil Controller to restrict deliveries for that purpose. According to the Housing Census of 1941, there were at that time 67,000 dwellings in Canada heated principally by oil. Nearly 90 per cent of these were in the Provinces of Quebec (25,800), Ontario (20,900) and British Columbia (13,800). In addition, there were

a large but unknown number of oil-burning installations used to heat stores and office buildings. Finally, there were in use several tens of thousands of small oil-burners of various types used chiefly for cooking and hot water heating.

The advantages of oil over coal for the space heating of small buildings are too well-known to require comment. Probably the greatest single advantage of oil is that it is normally used in equipment that is completely automatic. Coal-burning equipment that is completely automatic is also now available but it is still rather uncommon, the more usual domestic coal stoker requiring periodic attention to refill the hopper and to remove ash.

The principal disadvantage usually associated with the use of oil for domestic heating is its cost. The Commission has not undertaken the extensive survey that would have been necessary for it to determine the relative costs of oil and coal in various types of operations. A straightforward comparison on a cost-per-B.t.u. basis is of doubtful value for various installations burn different grades of fuel oil which sell at different prices and different types of oil and coal-burning equipment have different thermal efficiencies. Moreover, the adjustments for variations in cost other than for fuel, which would be necessary if the comparisons were to be accurate, are very difficult to estimate. To a considerable extent oil has been and will continue to be a luxury fuel for one simple reason, if no other, that the initial expenditure necessary for oil-burning equipment runs to several hundreds of dollars and is in itself a strong deterrent to the use of liquid fuel by the vast majority of coal users.

Nevertheless, there is much evidence to suggest that the trend toward oil for domestic heating will continue. We have received comments on current trends in the retail fuel market from well over 100 coal dealers from coast to coast and the great majority forsee some increase in the use of oil. This they attribute in part to a general trend towards more automatic heating equipment, in part, particularly in Central Canada, to reaction against some of the inferior coal available for domestic use during the later war years and in part to increases in the price of coal. It appears that in most, perhaps all, parts of Canada coal remains a cheaper fuel than oil and the use of liquid fuel, as of coal stokers, will continue to be restricted to those who can afford to pay for the convenience of automatic heat.

The consumption of petroleum products by industry for heating and for power is largely restricted to plants for the production, tempering and fabricating of steel, plants for the recovery of base and precious metals and by the heavy chemical, pulp and paper, sugar refining, liquor distilling and canning industries. The use of oil by central electric stations and under boilers in oil refineries has been excluded from the figures given above. Of the oil used by industry in 1939, about 70 per cent was used in Ontario and Quebec and a further 22 per cent in British Columbia.

There is a considerable variety in the industrial uses made of fuel oil and there is, consequently, considerable variation in the adequacy of coal as a substitute, apart from the cost factor. Where fuel oil is used for steam raising, as a large percentage of it is, coal is usually a satisfactory substitute, though in industries such as food products, laundries, film manufacture, glassware, etc., considerations of cleanliness and the absence of abrasive dust are very important. For several other uses coal could not be substituted directly. Examples of such uses are the heating of open-hearth furnaces and the dehydration of alumina.

Generally speaking, the fuel oil used by industry is much heavier than that used for domestic and building heating and it sells at a substantially lower price. In the fuel market it competes with bituminous coal. Even where coal could be substituted directly, industrial fuel oil is normally able to command a higher price than its theoretical heat value compared to coal would suggest, because the handling and firing costs of oil are usually lower. The increase in the

price of coal during the war years has increased the competitive strength of fuel oil in the industrial market and the indications at present are that the use of fuel oil by industry may continue to expand.

The reasons put forward by the railways for their use of oil as a locomotive fuel are summarized in the chapter on Markets. Except on mountain divisions, the consumption of oil by the railways is insignificant. There are a number of diesel switching locomotives used in Canada but their total annual fuel requirements are small. Current trends in the design of both coal and diesel locomotives in the United States are discussed in the chapter on Combustion. There is no indication that either major railway is contemplating the introduction into Canada of freight or passenger diesel locomotives.

Petroleum has competed more successfully with coal in the ships' bunkering market than in any other. The trend towards oil-burning ships was well established before 1914 and it has been estimated that by the end of 1937, of the world tonnage of merchant ocean-going vessels of 2,000 gross tons and over, about one-quarter was powered by diesel motors and the remainder was split equally between oil-fired and coal-fired boilers.

Oil has many advantages over coal for use in vessels. It can be stored in odd-shaped tanks built wherever desirable in the ship and can be loaded more quickly than can coal. Oil has greater heat value for weight and volume than has coal and, therefore, allows either more fuel or more cargo to be carried. On passenger ships cleanliness is a further advantage. So great, in fact, are the advantages of oil that the United States National Resources Committee declared in its report, published in 1939, that "cost may not even be a major determinant in deciding what fuel to use for marine service. Oil is so advantageous for steamships that there is a question whether coal is an effective competitor in that field."

The consumption in Canada of petroleum coke as a fuel has never exceeded 100,000 tons annually in the last two decades. In contrast to other products of petroleum, its use as a fuel has declined. The main use of petroleum coke is as a raw material. In 1944, 298,000 net tons of petroleum coke were so used as compared with 26,000 tons used as fuel.

Factors Affecting the Supply of Petroleum Products

The supply of the various products of petroleum is an excellent example of joint supply. With one or two exceptions, all liquid petroleum products are obtained from crude petroleum. As it comes from the ground crude petroleum is a mixture of a large number of hydrocarbons of varying volatilities. The most volatile liquid hydrocarbons constitute gasoline and, in descending order of volatility, come kerosene and the illuminating oils, light distillates such as stove oil, diesel fuel and furnace oil, and finally the residuals used in larger oil-burning equipments. Each of the above groups is a "fraction" or "cut" of the crude petroleum. The number of fractions that can be obtained is almost limitless but, for practical purposes, the specifications of marketable grades are usually widened sufficiently to reduce the number of fractions to manageable proportions.

The process of separating out of crude oil the various fractions desired is known as refining. Modern refining techniques are too complicated to allow of simple and yet accurate description but, unfortunately, it is impossible to understand the factors determining the supply of fuel oil without some appreciation of refining procedures. We shall, therefore, attempt an extremely simple statement of the main principles involved in the refining process.

The process is basically one of selective distillation. Since the various fractions have different boiling points, it is possible to separate them by simple distillation, a procedure known as "topping" the crude. The heating of the crude

may cause slight thermal decomposition but the operation of topping is essentially a physical one rather than a chemical one. The amounts of the various fractions obtained will vary with the character of the crude used and will be substantially the same as those previously existing in mixture in the crude.

The refining operation may stop with topping but there are at least two reasons for proceeding further. The first is that the yield of gasoline, the most valuable fraction, will be relatively small from topping, and the second is that the gasoline so obtained, called "straight-run" or "raw", has unsatisfactory knocking properties when used in a high compression engine. Other hydrocarbons resulting from further refining when mixed with straight-run gasoline reduce the tendency to knock.

After topping, the process is known as "cracking". This process employs high temperatures and pressures, and some of the heavier hydrocarbon molecules subjected to it are broken down, or cracked, into lighter ones. Thus an additional volume of hydrocarbons within the gasoline range of volatility is obtained. The additional gasoline is obtained at the expense of heavier hydrocarbons and so the further the cracking is carried the lower will be the volume of the fractions heavier than gasoline obtained from any given amount of crude.

In recent years there have been developed new cracking processes utilizing the catalytic technique and this development was accelerated during the war in order to supply high octane aviation gasoline, aromatics and raw materials for rubber synthesis. The catalytic cracking operation permits the refiner to further decrease the yield of residual fuel from any given crude.

The process of refining is by no means as simple as this description might lead one to suspect. There are many variations in conditions and methods and many additional treatments required for both the crude and the various fractions to improve their quality. For our purposes, however, it is sufficient to recognize that for any given crude the yield of heavier hydrocarbons will vary within wide limits depending upon the refining technique employed.

For any given refining technique the yield of the various fractions will vary considerably with different crudes, for crudes differ widely. Generally speaking, the lower the specific gravity of the crude used the higher will be the yield of gasoline. For that reason the price of crude petroleum at the well tends to vary inversely with its specific gravity.

Anyone who wishes to refine and market petroleum products thus finds himself forced to choose from a wide range of crude oils at different prices and a wide range of refining techniques. He will also find himself able to dispose of various volumes of the different fractions at various prices in the market open to him. His problem is to choose a combination of crude oil and refining technique such that, after disposing of the fractions resulting, the excess of his total revenue over his total costs is the largest possible. Since the gasoline fraction is normally the most valuable one, it might seem that the best refining procedure in any situation would be that which gave the greatest gasoline yield. There is a tendency for this to be the case but it is not necessarily so and it is, in fact, somet mes not so. The basic economics of petroleum cracking is that cracking will be profitable only when gasoline can be obtained more cheaply from the residue left from topping than from crude oil. In this connection the cost to the operator of the residue cracked must be taken as the amount for which it could have been sold. The profitability of cracking, or of further cracking, depends therefore on the relationship between the cost of crude oil and the price of fuel oil.

There is no doubt that the relationship between the cost of crude oil and the price of fuel oil varies from area to area and that this variation is at least part of the explanation of the difference in the extent to which crudes are cracked. In the United States, fuel oil must meet the competition of cheap coal in the industrial energy market with the result that the value of fuel oil relative to the value of crude oil tends to be low. For this reason, United States refineries have consistently tended to intensify their processing of crudes, and the percentage yield of fuel oil from United States refineries fell from about 31 per cent in 1930 to about 24 per cent in 1940. In catalytic cracking equipment fuel oil yields of 10 per cent or less are possible, and the installation of catalytic cracking facilities in the United States occurred to such a large extent during World War II that the fuel oil yield of all United States refineries is expected to be still lower in the future.

It is doubtful whether there is the same pressure on refineries in Canada to reduce the yield of fuel oil. Due to transportation costs the cost of crude oil in most parts of Canada is higher than it is in most parts of the United States, but the price at which fuel oil can be sold is also generally higher and the relationship of the value of crude oil to the value of fuel oil appears to be less favourable to intensive processing. In some measure this is probably due to the fact that coal is more expensive in most parts of Canada than in most parts of the United States. The relationship between coal prices and fuel oil prices in any particular area is sometimes a very complicated one, but, because coal is a more or less satisfactory substitute for fuel oil for many of the purposes for which fuel oil is used, the price of coal provides an upper limit beyond which the price of fuel oil cannot rise if fuel oil is to be used for those purposes. There are, however, areas in Canada where the price of fuel oil appears to be somewhat lower than the price of coal. The areas are those having free access to ocean tankers, and the price of fuel oil in these areas is very much influenced by the price at which fuel oil can be imported. In British Columbia, for example, fuel oil can be imported from California, and it is in fact imported in considerable volume. The price at which Canadian refineries can sell fuel oil is limited by the laid down cost of imported fuel oil and may bear no direct relationship to the price of coal. Refineries in British Columbia do little more than top relatively heavy crudes and the fuel oil yield of the refineries is therefore high. If they were to crack extensively, the gasoline requirements of the area could be made from a considerably smaller volume of crude but much more fuel oil would be imported, and the resulting situation would not necessarily be any more favourable to the producers of coal in the Province.

Whatever the explanation, it seems that high fuel oil yields are less unsatisfactory to the refiner in Canada than they are in the United States. Imperial Oil Limited and McColl Frontenac Oil Company Limited are at present planning the erection of modern catalytic cracking plants at Montreal, but the plants are required to improve the quality of the lighter fractions rather than to decrease the volume of the heavier fractions. It seems reasonable to expect that the gasoline yield of Canadian refineries will not change materially in the near future and that the increase in gasoline consumption which may be expected will be accompanied by an increase in fuel oil marketed, providing that there is no considerable increase in the cost of crude oil to these refineries. Attention must therefore be directed to the sources of crude petroleum used in Canada and to the factors affecting future supply and price of crude petroleum.

The Supply of Crude Petroleum

Most of the petroleum products used in Canada are refined in Canadian refineries. The dependence of Canadian refineries on foreign sources for their crude petroleum is shown in the following table:

REFINERY REQUIREMENTS AND CANADIAN PRODUCTION OF CRUDE PETROLEUM: 1939 AND 1944

(In Barrels of 35 Imperial Gallons per day)

—	1939		1944	
	Refinery Requirements	Canadian Production	Refinery Requirements	Canadian Production
Maritimes	12,000	60	20,000	60
Quebec	41,000	Nil	45,000	Nil
Ontario	34,000	560	60,000	360
Prairies and Northwest Territories	21,000	20,800	35,000	27,000
West Coast	15,000	Nil	20,000	Nil
Canada	123,000	21,420	180,000	27,420

Only on the Prairies is there any appreciable amount of crude petroleum produced in Canada. The main producing field there is that of Turner Valley in Alberta, which reached a peak crude production of about 26,500 barrels per day in 1942, in addition to 830 barrels per day of natural gasoline. Since that year crude production has declined to 20,300 barrels per day in 1945. All other fields in Alberta produced 1,730 barrels per day of crude petroleum in 1945. In late war years the Norman field in the Mackenzie District of the Northwest Territories has grown in importance. Its crude output grew from 200 barrels per day in 1942 to 3,100 barrels in 1944. The development of that field, part of the Canol Project, was undertaken jointly by the Governments of Canada and the United States to develop oil in the Northwest Territories for defence purposes. The Norman field is too remote to be of immediate importance in supplying the normal petroleum requirements of the Prairie Provinces.

In pre-war years, Alberta oil production was adequate to supply Prairie oil requirements as far east as Winnipeg. With the wartime increase in demand and the falling off in the Turner Valley output, domestic production was able to meet the demands of Alberta and the eastern fringe of British Columbia only. Saskatchewan and Manitoba refineries turned therefore to United States sources, first to Montana, then to Wyoming and Oklahoma fields, and, on occasion, even to Texas and Louisiana. In recent months Montana has been providing this market with some 3,000 barrels per day, and Wyoming and Oklahoma with some 10,000 to 11,000 barrels per day.

The crude supply for British Columbia refineries comes normally from Southern California, although during the war emergency and at other times under special conditions, crudes from Venezuela, Colombia and Ecuador have been used.

Most of the crude oil used in Ontario comes from Illinois and the Mid-Continent (mainly Kansas and Oklahoma) field. During the war this oil was moved by pipeline to Toledo and then by tanker to Toronto, or by tanker or pipeline to Sarnia, at which points the largest refineries are located. During the war some crude came by pipeline to Ontario from as far as Texas. Ontario's access to both pipeline supply and water-borne shipments is important for it allows more freedom of choice between South American and United States crudes than would otherwise exist.

Crude oil for Quebec and Maritime refineries now comes almost entirely from South America, mostly from Venezuela but also from Colombia. Both Montreal and Halifax have ready access to southern United States sources as well as South American sources. Wartime construction of the Portland-Montreal pipeline has given Montreal year-round access to the eastern seaboard oil market. It is not expected, however, that the use of that line will reduce the transportation charges on crude imports below the pre-war tanker rates.

There is general agreement that the petroleum requirements on the North American continent will continue to expand for some time in the future. At the same time concern has frequently been expressed as to the adequacy of United States sources to meet the growing demand. If, in fact, a shortage should develop, the price which Canadian importers would have to pay for their crude requirements would rise considerably, probably inducing them to alter their refining techniques. It is, therefore, relevant to enquire into the adequacy of supply in the world market for crude petroleum.

The world crude petroleum production in 1938, the last fairly normal pre-war year, and in 1945 was as follows:

CRUDE OIL PRODUCTION

—	1938		1945	
	Barrels per Day	Per cent of World Production	Barrels per Day	Per cent of World Production
North America	3,500,000	64	4,900,000	65
of which U.S.	3,300,000	61	4,700,000	62
South America	670,000	13	1,050,000	14
of which Venezuela	520,000	10	880,000	12
Europe	720,000	13	980,000	13
of which U.S.S.R.	560,000	10	820,000	11
Middle East	330,000	6	490,000	6
Far East	220,000	4	160,000	2
Total World Production	5,440,000	100	7,580,000	100

SOURCE: The Oil Weekly for February 11, 1946.

Of these areas, the U.S.S.R. and the Far East consumed in 1938 about what they produced. The great vacuum for oil was Western Europe, and oil poured in from North America (about 250,000 barrels a day), South America (about 300,000 barrels) and the Middle East (about 170,000 barrels)*.

The figures of production in 1945 are of interest in that they show how the recent war was "oiled", and they give an indication of productive capacity in the short run, but they are not necessarily reliable as an indication of supply in the long run. The rates of production achieved during the war can be maintained, and, in time, increased, only if there is enough oil left in the ground to allow it.

What the war has done to United States petroleum reserves depends in large part on how the question is defined. There are two methods used to estimate the annual change in United States reserves, and they differ in the treatment they give to oil found during the year. Oil is found only by drilling, but the oil so found may be that of a newly discovered pool, or it may be that of a pool already known but the size of which has been underestimated. The former is found by explanatory drilling, the latter by development drilling. The practice of the American Petroleum Institute is to treat oil found in a year by either kind of drilling as an addition to proven reserves in that year, and to compare that addition with the year's production to determine whether proven reserves rose or declined during the year. On this basis the A.P.I. estimate that United

* From evidence given by W. B. Heroy, U.S. Petroleum Administration for War, before the Pilot Hydrogenation Plant Committee in Ottawa, January 21, 1946.

States proven reserves have increased continuously since 1933, except for 1943. Proven reserves at the end of 1933 were estimated at 12 billion barrels; they increased rapidly to 19 billion at the end of 1940 and then slowly to 21 billion barrels at the end of 1945.

The United States Petroleum Administration for War was necessarily concerned principally with the rate at which new sources of supply were being discovered. Therefore it began its own compilation of reserve estimates and credited all oil proved by development drilling back to the year in which the source of supply was discovered, on the grounds that the pool had already been found and that later development had merely furnished a more accurate estimate of the size of the original discovery. On that basis known crude reserves reached a peak of 24.5 billion barrels at the end of 1938 and have declined steadily, except for 1940, to 22.5 billion barrels as at January 1, 1945. The Petroleum Administration recognizes that the method used exaggerates somewhat the downward trend since 1938 for the size of new oil pools found in the period may have been underestimated, but it maintains that such exaggeration as there may be, however, does not obviate the important fact that the discoveries have not kept pace with consumption.

From a study of the results of exploration the Petroleum Administration came to the conclusion that the discovery of new fields, especially prolific fields, was becoming increasingly difficult and costly. The fields which are easiest to find seem to have been found, and new discoveries are being made at progressively greater depths, and after more expensive geophysical analysis. The average drilling depth during the war period showed an increase of about 16 per cent. In spite of the fact that from 1937 to 1945 wildcat drilling (i.e. drilling in search of new oil pools) increased by about 75 per cent and geophysical prospecting by about 90 per cent the rate of discovery began to diminish in 1939.

The realization that increased United States petroleum production has not been accompanied by an equal rate of discovery of new oil pools has led to two very different schools of thought in that country. The oil producers tend to favour import restrictions in the belief that supply and demand economics would operate to maintain adequate supplies. Others feel that some effort should be made to conserve home oil resources by bringing in from foreign countries oils which would move most economically. These would tend to be the heavier crudes, used primarily to provide heat. This is the basic issue in petroleum policy in the United States today.

What does seem reasonably clear is that if the United States is to continue to produce at home all the oil it requires the price of crude must move steadily upward, for not only is new oil becoming more expensive to discover, but known pools are becoming more costly to exploit. Therefore, if there were not other sources of supply available to Canada there would be some cause for concern about the price we might have to pay in the future for crude petroleum. There are, however, very large proven oil reserves in various other countries. Estimates of proven reserves in the principal oil-producing countries as at January 31, 1944, are given below:

—	Billion Barrels	Percentage of World Proven Reserves
United States	20.0	40
Venezuela	5.6	11
Other South American	1.1	2
Europe—excluding U.S.S.R.	0.6	1
U.S.S.R.	5.9	12
Middle East	15.7	32
Far East	1.1	2
World Petroleum Reserves	50.0	100

It must be emphasized that the figures given are for proven reserves only. No allowance has been made for oil believed on the basis of geological or geophysical information to be present but not yet actually proven or the size of the reservoir estimated.

It is interesting to compare the extent to which reserves were drawn on annually, called the rate of extraction, in some of these countries. During the war the rate of extraction for the United States was about 8.5 per cent per year, for the Caribbean area about 5.75 per cent, for Russia it was thought to be about 5 per cent and for the Middle East it was a little over 1 per cent. These figures indicate how much less pressure there was on reserves in countries other than the United States. As time passes, these other reserves will probably be exploited increasingly and from them may well come the flow of oil necessary to offset stationary or dwindling production in the United States. As these other fields are developed it is expected that proven reserves in them may be very greatly increased. As the Middle East production is increased, it may well displace South American oil in Europe, leaving increasing quantities of South American oil available to meet the needs of the North American continent.

Conclusions

The post-war world trade in petroleum will probably be of much the same pattern as it was in 1938, except that the Middle East will probably be a much more important source of the oil flowing into Europe than it was before the war. The flow of oil into Europe from the Western Hemisphere will thus be curtailed and may even cease as soon as additional pipeline capacity can be provided to carry oil to Mediterranean loading points. Probably before 1950, the date depending a good deal on the Government's petroleum policy, the United States will be on balance an oil importer. Its imports will likely be principally the heavier oils, and will come from the Caribbean area.

Insofar as Canadian requirements are concerned, the Caribbean is likely to become an increasingly important source. For Quebec and the Maritimes that raises no particular problems, for they are buying much of their oil there now. Montreal, Toronto and Sarnia all have access to water shipments in the summer, and Montreal and Sarnia can receive oil by pipeline from the American eastern seaboard; however, Toronto and Sarnia can be supplied from the eastern seaboard only at higher costs than they have hitherto incurred. As United States consumption grows and as and when United States conservation measures are increased, British Columbia refiners may be forced to turn in part to other fields, probably to the Caribbean. Since oil from that source must come through the Panama Canal, where the toll is at present 10 cents per barrel, as well as make a longer ocean trip, costs of laid down crude could be expected to rise somewhat. But there is no reason for assuming that the increases are either imminent or will be serious.

Only on the Prairies is there any indication that the supply problem will be serious and there only if no important new oil fields are discovered. The Turner Valley and Montana fields, as now developed, are inadequate to meet current requirements. The Prairie refineries thus have to go to the Wyoming and Mid-Continent fields, with correspondingly high transportation costs. Failing new discoveries of oil on the Prairies, oil will be appreciably more expensive there than it was before the war.

For Canada generally, it appears that oil supplies in the next decade will be neither inadequate nor very much more expensive than they have been. Such price increases as do occur may well be no more than those which have occurred during the war years, or may yet occur, for coal. There thus appears no prospect of a substantial decline in the competitive position of oil in the markets where it

competes with coal. Since the information available suggests a growing demand for fuel oil, it seems probable that the invasion by oil of coal markets will continue for some years yet. The rate may taper off soon and may reverse within a decade or two. But the flow of oil has not yet reached its peak.

WOOD FUEL

It has already been emphasized that wood fuel is an important source of energy in Canada. Failure to include it in estimates of total energy used in Canada is justified only by the inadequacy of statistical material on wood fuel consumption. More wood is used in this country for firewood than for pulp and paper manufacture, and almost as much as for lumber production. According to the 1941 Census of Housing about as many dwellings were heated principally by wood and its products as by coal and coke in that year. In addition, in some areas wood fuel is used extensively for industrial steam raising. From the limited information available, it appears that the energy obtained annually from wood fuel is about the same as that obtainable from 5 to 6 million net tons of anthracite coal. The figures from 1926 to 1942 have fluctuated considerably, but no definite trend is discernible.

The wood used as fuel in Canada is mainly either cord-wood cut for fuel purposes or the by-product of lumbering operations. The by-product fuel consists of slabs and edgings, lumber trimmings, shavings and sawdust left after the manufacture of logs into lumber. This material constitutes the so-called mill-waste of sawmill operations.

More than 80 per cent of the wood fuel consumed is cut for firewood. The unit of measurement is a volume one, the cord, which is 128 cubic feet. Due to air space in the piling of cordwood, a cord has been estimated to contain on the average about 90 cubic feet of wood material. The weight of a cord varies enormously with the kind of wood but even for the lighter woods it is usually greater than one ton.

Most of the cordwood used in Canada is cut on farms. An estimate of the amount of wood so cut is provided by the decennial census. For the last three census the figures obtained were:

1920	8,529,000 cords
1930	8,086,000 cords
1940	8,467,000 cords.

Of the cordwood cut on farms, about 75 per cent is consumed on the farm; only some 25 per cent is sold. The amount of cordwood cut on farms varies greatly from province to province. Of the volume cut in 1940, 41 per cent was in Quebec, 22 per cent in Ontario, and 24 per cent in the Prairie Provinces.

In addition to cordwood cut on farms, there is an appreciable amount produced by other operations in the woods. Estimates of these amounts have been added to the farm production to give the following figures for total annual cordwood production:

FIREWOOD CUT IN OPERATONS IN THE CANADIAN WOODS

(In millions of cords)

1926	9.3	1932	8.5	1938	9.0
1927	9.4	1933	8.6	1939	9.1
1928	9.5	1934	8.7	1940	9.2
1929	9.7	1935	8.8	1941	8.6
1930	10.1	1936	8.9	1942	8.7
1931	10.3	1937	9.0		

Source: Annual report "Operations in the Woods" D.B.S.

The heating value of cordwood varies greatly with the kind of wood and with the moisture content. Assuming 20 per cent moisture and 90 cubic feet of wood material per cord, the number of cords of wood required to equal 1 ton of anthracite coal runs from 1 cord for rock elm to 2.4 for balsam fir[1]. The cordwood equivalents for some of the more common fuel woods in Canada are given below:

> Beech 1.13 to 1.35, Hard Maple 1.08 to 1.30, Aspen Poplar 1.77 to 2.13, Douglas Fir (coast type) 1.50, Western Red Cedar 2.25, Western Hemlock 1.95, Jack Pine 1.75.

With such variation from species to species it is difficult to arrive at a weighted national average to use in converting cordwood production to equivalent tons of coal. The rate of 1.75 cords per ton of anthracite coal is considered to be a fair estimate for the whole of Canada. On that basis, Canadian cordwood production has been the equivalent of about 5 million tons of anthracite coal. If 1.75 is the proper national average it is certainly not correct for individual regions. It is, for example, much too high for the Ottawa Valley and for southern Quebec, and much too low for the Prairies and for northern Ontario and northern Quebec.

The principal use of wood cut for fuel is in domestic establishments. According to the 1941 Housing Census, 46 per cent of Canada's dwellings were heated principally by wood (excluding sawdust) in that year. Approximately 80 per cent of farm dwellings and 60 per cent non-farm of rural dwellings were heated principally by wood. The wood fuel used for rural heating is thought to be almost entirely cordwood cut for the purpose.

In comparison with the consumption of cordwood cut for fuel purposes that of mill-waste is not great. It is, however, by no means insignificant for it appears to have amounted to well over the equivalent of 1 million cords annually in recent years. Since mill-waste is a by-product of lumbering operations, its production varies more or less with lumber output. A part of their mill-waste is used by some sawmills for steam raising, and the remainder is usually sold for fuel if there is a market to absorb it; if not, it is burned in refuse burners or carted off as refuse simply to get rid of it. Except for British Columbia, the only mill-waste that appears to be sold for fuel is slabs and edgings, for which the unit of sale is the cord. For the year 1943, just over 400,000 cords of this form of mill-waste were reported to the Dominion Bureau of Statistics as sold by sawmills in provinces other than British Columbia, about 55 per cent of it in Quebec, 30 per cent in Ontario and the rest in New Brunswick. While these figures are conceded to underestimate the importance of mill-waste fuel in these provinces, no better estimates are available.

There is apparently more mill-waste used as fuel in British Columbia than in all the rest of Canada. In addition to the use of slabwood as fuel, there are in that province large amounts of sawdust and hogged fuel used for fuel purposes. Hogged fuel is produced by feeding larger pieces of mill-waste into a "hog" or refuse chipper to reduce them to smaller sizes which may be machine-fed to furnaces. In British Columbia both sawdust and hogged fuel are sold in units of 200 cubic feet, called a "unit". No annual figures are available on the consumption of mill-waste for fuel in British Columbia, but estimates for recent years have been as high as 630,000 units of sawdust, 230,000 units of hogged fuel, and 400,000 cords of slabs and edgings, exclusive of amounts used by sawmills. Since the same volume of wood material is contained in about 1.2 units of sawdust or 1.3 units of hogged fuel as in 1 cord of slabwood[2] it appears

[1] "Heating Value of Wood Fuels" by J. D. Hale, Forest Products Laboratories of Canada, Department of Mines and Resources, 1933.

[2] Forest Service Circular 48 "The Utilization of Sawmill Waste and Sawdust for Fuel", by J. H. Jenkins and F. W. Guernsey, Forest Products Laboratories, Department of Mines and Resources.

that mill-waste sold by sawmills for fuel purposes exceeds the equivalent of 1 million cords. Additional unknown amounts are used as fuel by the sawmills. The figures are far too uncertain to allow a reliable estimate of the coal equivalent of mill-waste used as fuel in British Columbia, but very rough approximations suggest that it is probably not less than 500,000 tons and may be nearly 1 million tons of anthracite coal.

The greater part of the wood fuel used in British Columbia is used for domestic heating in the Greater Vancouver area. The burning of sawdust requires a furnace or heater attachment specially designed for the purpose. Sawdust is fed to the burner attachment by gravity from a hopper and the rate of combustion is controlled by the volume of air admitted. With such equipment sawdust is a satisfactory fuel, for it is clean, economical, and provides a steady heat with a minimum of attention. For domestic use Douglas fir sawdust is considered much preferable to western hemlock, western red cedar, or sitka spruce sawdust.

Hogged fuel is used mainly for industrial steam raising. During war years a special effort was made to increase the amount of it used in the pulp and paper plants on the west coast to replace the fuel oil normally used. In late war years three pulp and paper plants used nearly 200,000 units per annum of hogged fuel in addition to that which they manufactured from their own waste.

There is good reason to believe that the production of wood cut for fuel purposes has declined steadily and appreciably since 1941. Naturally the decline has been largely concentrated in wood produced for sale rather than for farmers' own use. According to some opinions the amount of firewood produced on farms for sale in 1940 has since been reduced by about 1 million cords, or nearly 50 per cent. The reduction is explained in part by the man-power shortage of war years and in part by the long term trend towards depletion of the more accessible wood lots. It may also reflect what has been called the "depression nature" of wood fuel production, namely, that it tends to be high when cash incomes of the producers are low and vice versa. This characteristic of cordwood production suggests that supply in the post-war period will depend to a considerable extent on the general level of prosperity in the country. If unemployment is high and farm incomes low more wood fuel will be available than if the reverse is the case. This cyclical movement will probably be superimposed on a long term downward trend due to wood-lot depletion. However, the use of wood cut for fuel purposes is expected to rise above the level of the late war years, and the probable long term decline in the energy obtained from wood cut for fuel purposes is not likely to be of more than local importance.

The future trends in the fuel use of mill-waste are more uncertain. Since mill-waste is a by-product of lumbering operations, and since lumbering operations may be expected to be maintained at a high level for some years to come, the overall production of mill-waste may be expected to be great. There are, however, indications that the amount of mill-waste used in Canada for fuel purposes may decline. In the past four years efforts have been made in Quebec and the Maritimes to prepare and market spruce mill-waste for chemical pulp chips. On the west coast the use of western hemlock chips in pulp and paper plants appears to be increasing. Hemlock mill-waste has not been an important domestic fuel, but it has been used for steam-raising and the increasing use of it for non-fuel purposes will tend to reduce the mill-waste of other species made available. Efforts are currently being made to develop a method for making wall-board from Douglas fir mill-waste. Should they be successful, they will increase the demand for that species of mill-waste.

The decline, both relative and absolute, in the importance of Douglas fir in the total British Columbia lumber production is expected to continue and it will probably further complicate the sawdust situation in Greater Vancouver. Although the installation of sawdust burners in that area continued during the

war years to such an extent that it had to be controlled, the requirements of sawdust users normally exceeded the supply of sawdust. The recent closing of the sawmill in Bellingham, Washington, has increased the pressure on producers and dealers to export mill-waste to the United States.

It seems probable, therefore, that the use of mill-waste for fuel purposes in British Columbia generally, and in Greater Vancouver in particular, will decline, although it is very difficult to say how rapid the decline will be. The development of alternative uses for mill-waste may change the situation rapidly in a fairly short period, but it seems more likely that the trend will be definite but gradual.

NATURAL GAS

Since 1926 natural gas has supplied somewhat over 2 per cent of the energy obtained in Canada from all sources. Although it is of considerable local importance elsewhere, only in Alberta is natural gas used in sufficient quantities to warrant calling it an important source of energy. In that Province it probably supplies at least one-quarter of the energy obtained from all sources.

Natural gas is essentially a petroleum product. It comprises the lighter hydrocarbon gases (largely methane, with some ethane and varying proportions of heavier hydrocarbons such as propane) which are not readily condensed or compressed to a liquid. It is frequently obtained as a by-product of oil production and it has then to be separated from the oil or liquid fractions. It may also occur as a dry gas with little or no liquid fractions. It is normally sold on a volume basis, the unit being either a cubic foot (CF) or 1,000 cubic feet (MCF). The gross heat value of natural gas is usually about 1,000 B.t.u. per cubic foot under standard conditions (14.5 lbs. per square inch pressure and 60° F.). On this basis, 26 MCF of gas are the equivalent of one ton of 13,000 B.t.u. coal, although in most combustion equipment less than 26 MCF are required to replace a ton of bituminous coal because of the higher thermal efficiency obtained with gas. In the discussion that follows it may be useful to keep in mind that 1,000,000 MCF of natural gas is the theoretical equivalent of about 40,000 tons of bituminous coal.

Natural gas is produced in Canada in every province from New Brunswick west to Alberta, inclusive. There are, however, only three areas where it is of any importance, namely, in New Brunswick near Moncton, in the southwestern tip of Ontario, and in Alberta and western Saskatchewan. In 1944 the production of each of these areas was approximately as follows:

—	Natural Gas Production	Theoretical 13,000 B.t.u. Coal Equivalent
	MCF	Net Tons
New Brunswick	700,000	27,000
Ontario	7,100,000	273,000
Saskatchewan	120,000	5,000
Alberta	35,000,000*	1,350,000

* Exclusive of gas wasted.

The natural gas production of New Brunswick is relatively very small. The Stoney Creek field near Moncton supplies Moncton and Hillsborough and certain localities in Albert and Westmoreland Counties with gas used mainly for domestic purposes.

The main producing fields in Ontario are the Tillbury and Haldimand fields in Kent and Haldimand Counties. Production of natural gas in Ontario rose during the 1930's from about 7,000,000 MCF annually to over 13,000,000 MCF in 1940. Although the demand for natural gas continued to grow, the resources of the area were not adequate to allow production to continue at the 1940 level and, in the years since 1940 gas demands have had to be met increasingly by gas provided by the Imperial Oil refinery at Sarnia and by coke ovens rather than by the natural product. In 1945, natural gas production had fallen to about 7,200,000 MCF, while a further 3,500,000 MCF of gas was provided from other sources. The principal markets for natural gas in this area are the urban centres of Windsor, London, Chatham and Sarnia. A portion of the gas is used for industrial purposes but the major part is used for domestic and commercial purposes, that is, for cooking, water heating and space heating.

The inadequacy of the natural gas resources in the area to meet local market requirements has led the major distributor, the Union Gas Company of Canada, to enter into an arrangement with the Panhandle Eastern Pipeline Company of the United States for the importation of natural gas from that country. This agreement was authorized by the United States Federal Power Commission on April 23, 1946. According to the terms of the agreement, the Union Gas Company is permitted to receive from Detroit during the months of April to October inclusive up to 5,500,000 MCF of natural gas in any calendar year. The Union Gas Company proposes to pipe this gas to the partially-exhausted Dawn Field in Lambton County and there store it underground to have it available to meet the company's peak-load requirements of the winter months. When the construction necessary for this to be done is completed, the imported natural gas will supplement local production in serving the area supplied by natural gas in 1940. The first effect of the imported gas will be, therefore, not a further invasion of coal markets but a maintenance of supply in the area already served.

The Federal Power Commission has required the Panhandle Eastern Pipeline Company to give priority to all natural gas purchasers in the United States which may, in the short run, reduce somewhat the volume of natural gas available to the Union Gas Company. However, natural gas pipelines from the major United States natural gas fields of Texas, Oklahoma and Kansas into northern and eastern parts of the United States are expanding very rapidly and at least one additional pipeline from the producing fields to Michigan is planned. It is, therefore, probable that in the course of the next few years much more natural gas will be available for importation into Ontario from the United States than there is at present.

By far the largest reserves, both proven and potential, of natural gas in Canada are in Alberta and in western Saskatchewan. Until recently the discovery of gas fields has been largely incidental to the search for oil. The market has been largely limited to the local needs of Lethbridge, Calgary, Edmonton and contiguous areas, and very little need was felt to develop further gas reserves. Much more attention was directed to utilizing such gas as was produced incidental to oil production and to reducing the waste of that gas. Recently, however, active exploration has been undertaken throughout Alberta and western Saskatchewan to discover new natural gas fields. As a result of this activity, the reserve situation is at present somewhat uncertain; estimates by competent authorities vary within wide limits. There is undoubtedly a good deal more natural gas in Alberta and western Saskatchewan than was, until recently, suspected and there may be a good deal more than that which is presently known. Under such circumstances, the estimates of proven reserves quoted in this report must be considered as tentative only. The following comments on the main known reserves are intended to give no more than a general idea of these reserves as they appear at the moment.

The Turner Valley field, 30 miles southeast of Calgary, produces large quantities of wet gas incidental to the production of oil. Reserves of gas are apparently somewhere between 300 to 400 million MCF. There is still a considerable amount of gas wasted in this field but it is being steadily reduced by conservation measures. The gas contains both gasoline and sulphur and is, therefore, treated in an absorption plant to remove the gasoline and a scrubbing plant to remove the sulphur before it is distributed commercially.

The Medicine Hat-Redcliffe field lies in and west of Medicine Hat. It is a dry gas field producing from wells 1,000 to 1,500 feet deep. Reserves have been estimated at about 125 million MCF, but this is probably a minimum figure for there is cause to believe that the field is more extensive than has usually been assumed.

The Princess-Steveville field, located some 60 miles northwest of Medicine Hat, is presently also classified as a dry gas field. The gas is found at a depth of some 3,900 feet. It has known reserves of at least 80 million MCF and the possibility of much greater reserves is good.

The Viking-Kinsella field, some 70 miles southeast of Edmonton, is a dry gas field and has the largest known reserves in Alberta. Estimates of proven reserves in this field vary from 500 million MCF to nearly twice that figure. The gas is free from sulphur and is found at a depth of some 2,200 feet.

There are smaller natural gas reserves which have not been developed at Foremost, Brooks, Tilley and various other places. Very recently important new gas reserves were reported to have been discovered by the McColl Frontenac Oil Company in what is to be known as Pakowki Lake field, south of Medicine Hat. In the latter part of 1944, in the course of searching for oil, large gas flows were tapped at Jumping Pound, about 25 miles west of Calgary. Similar flows have been located at Brazeau.

The two largest fields in Saskatchewan are in the vicinity of Unity and at Lloydminster. The proven reserves of the former field amount to about 25 million MCF. The latter field, which is primarily an oil field, is thought to have a potential at least equivalent to that of the Unity field. A further field has been discovered at Lone Rock, 15 miles southeast of Lloydminster, but this field has not been developed to the point that an estimate can be given of its reserves. A good deal of exploratory drilling has been done in the southern part of the province but so far the results have not been promising.

There are four pipeline systems for the distribution of natural gas in Alberta: that of the Canadian Western Natural Gas, Light, Heat and Power Company Limited serving the Calgary-Lethbridge area, of the Northwestern Utilities Limited serving Edmonton and area, and those of two municipal systems serving Medicine Hat, Redcliffe, Vermilion and Brooks. Of these, the first is the largest. It began as a pipeline of some 170 miles from the Bow Island field to Calgary; later, as Turner Valley developed as a natural gas producer, the wells there were tied into the line and became the major source of gas for the system. From Bow Island the pipeline was also extended 30 miles south to tap the Foremost field. The system today serves a number of towns on its route from Foremost to Calgary, the largest of which is Lethbridge. The next largest system is that of Northwestern Utilities, serving Edmonton. This system draws its gas from the Viking-Kinsella field and pipes it 90 miles to Edmonton, serving a number of towns en route. An extension of this system, almost 100 miles southwards to Red Deer, is at present under construction. The two municipal systems of Medicine Hat and Redcliffe draw their supplies of natural gas from the Medicine Hat-Redcliffe field and serve their respective urban areas.

The disposition of natural gas from these systems, and also the field use and wastage of gas for the years 1939 and 1944, are shown in the following table, in units of 1,000 MCF:

—	1939	1944
	MMCF	MMCF
To Domestic Use—		
Calgary—Lethbridge System	3,437	4,262
Edmonton and Towns System	1,843	3,150
Medicine Hat—Redcliffe (estimated)	450	600
Other Towns	160	343
Total Domestic	5,890	8,255
To Commercial Use—		
Calgary—Lethbridge System	1,906	3,681
Edmonton System	1,047	2,681
Medicine Hat—Redcliffe (estimated)	200	350
Total Commercial	3,153	6,712
To Industrial Use—		
Calgary—Lethbridge System	968	2,287
Edmonton System	514	1,311
Medicine Hat City Power and Industry (by Diff.)	605	1,310
Medicine Hat—Redcliffe Area	1,364	1,790
Imperial Oil Refinery, Calgary	1,266	1,847
Alberta Nitrogen Co., Calgary	....	3,240
Total Industrial (Excl. field use)	4,717	11,785
Field and Miscellaneous Use	9,361	8,187
Total Use	23,121	34,939
Repressured Bow Island	165	....
Waste and Shrinkage	28,316	18,326
GRAND TOTAL	51,602	53,265

Source: Alberta Conservation Board and C.W.N.G.

The use of natural gas for domestic purposes includes its use for cooking, refrigeration, water heating and space heating. For the first two of these, it is directly in competition with electricity; for the last two, with fuel oil and coal. The largest use is undoubtedly that for space heating. It is estimated that 90 per cent of the urban dwellings in Calgary, Lethbridge and Medicine Hat, and perhaps 70 per cent of those in Edmonton, are at present heated principally by natural gas. The commercial use of gas is likewise largely for space heating of restaurants, office buildings, stores and apartment blocks in the various areas. There may be some increase in the use of natural gas for domestic and commercial purposes in the Edmonton area, but otherwise expansion of the market will depend largely on pipeline extensions. The domestic and commercial use of gas in 1944 was about 15 million MCF. or the equivalent of about 575,000 tons of 13,000 B.t.u. coal or 750,000 tons of 10,000 B.t.u. coal.

Natural gas may be used industrially as either a fuel or a raw material. As a raw material it may be used for the production of ammonia, synthetic fuels, carbon black, methyl alcohol, formaldehyde, and a great variety of other chemical compounds containing carbon and/or hydrogen. The only substantial use as a raw material at present is that by the Alberta Nitrogen Company for the manufacture of synthetic ammonia. This plant was built during the war years for the Federal Government by the Consolidated Mining and Smelting Company of Canada to make military explosives, using natural gas and hydro-electric power. It was found to have a capacity in excess of the demand for explosives and used this excess capacity for the manufacture of commercial ferilizer

for home and foreign markets. So far it has met with considerable success in this field. In the last three years this plant has used about 3 million MCF of natural gas annually. The largest single use of natural gas as an industrial fuel is in the Turner Valley oil fields for the operation of pumps, for oil refining and for space heating. The next largest industrial user is the Imperial Oil refinery at Calgary. Other important industrial users include brick plants, flour mills, a power company, a glass plant, packing plants, bakeries and laundries.

The use of natural gas in Saskatchewan is limited to the immediate vicinity of the producing fields for there are no pipeline systems of any size in that Province. It appears that reserves at Unity are adequate for the towns of Wilkie and North Battleford, and that the construction in the near future of a pipeline to serve these towns is very likely.

The following table is presented to give some indication of the comparative cost of natural gas and of coal in the areas served by the two largest natural gas distributors. It shows the average price paid by different classes of consumers for natural gas delivered by the two systems in 1944 and the equivalent value per ton of 10,000 B.t.u. coal, based on 945 B.t.u. gas at Edmonton and 1,000 B.t.u. gas at Calgary, and on the assumption of equal thermal efficiency. Since, in fact, the thermal efficiency of natural gas is usually somewhat higher than that of coal, the value of a ton of coal is in each case somewhat overstated. Finally, the table also includes delivered prices in Edmonton and Calgary of various sizes of coal from the Edmonton and Drumheller fields, respectively.

—	Canadian Western		Northwestern Utilities	
	Average Price per MCF	Equivalent Coal Value Per Net Ton	Average Price per MCF	Equivalent Coal Value Per Net Ton
	Cents	$	Cents	$
Domestic	27.2	5.44	30.4	6.43
Commercial	22.37	4.47	23.0	4.87
Industrial	16.76	3.35	17.1	3.62

Coal	1944 Retail Price at Calgary	Coal	1944 Retail Price at Edmonton
	$		$
Drumheller lump	8.25	Edmonton District lump	5.15
stove	7.25	egg or stove	4.65
nut	5.85	nut	3.65
stoker	3.50	stoker	2.35
slack	2.50	slack	1.85

The coal prices above are for coal delivered in relatively small amounts. Commercial customers were usually given a discount of about 50 cents and industrial consumers sometimes more, depending upon the competitive situation.

To forecast the use to be made of natural gas in western Canada in the next few years is extremely difficult. Natural gas reserves are clearly much more than adequate for present markets and, therefore, some considerable development in the use of the product is to be expected, but there are several lines along which such development may proceed. As an example of one of the possible lines, this Commission has had presented to it a study designed to show that, assuming adequate reserves, the transmission and distribution of natural gas from Alberta to urban centres in Saskatchewan and Manitoba is technically

feasible. It is estimated that such a development, should it occur, would displace approximately 1,000,000 tons of coal annually. If, in addition, a northern line were constructed, to serve Saskatoon, North Battleford, Prince Albert, etc., a further 200,000 tons of coal might be displaced annually.

In view of the rapid growth in the United States in recent years of long-distance transmission of natural gas, a pipeline from Alberta to Winnipeg (a distance of from 630 to 730 miles, depending upon the field chosen) would not be remarkable insofar as its length was concerned. Natural gas lines in the United States now reach from the oil and gas fields of Louisiana and Texas as far North as Chicago and Detroit and as far east as West Virginia for distances of from 1,000 to 1,500 miles. There are, however, a number of considerations which suggest that a forecast of any similar development in western Canada is somewhat premature.

In the first place, the reserve situation in western Canada is at present very uncertain. There is little agreement among competent authorities about the reserves of most of the fields, particularly about those from which the gas for such a project would be taken. Furthermore, even if it were clear that total reserves in Alberta are adequate for such a project, the undeveloped nature of Saskatchewan gas reserves would discourage pipeline construction from Alberta, for further exploration in Saskatchewan might reveal large reserves much nearer to the market to be served. It is the hope of operators in the Lloydminster-Unity-Lone Rock triangle that sufficient reserves will soon be found to supply the northern part of the Province including Saskatoon, but it appears that proven reserves are not at present sufficient to justify such an undertaking.

Even should reserves in Alberta be adequate and the economics of pipelines into Saskatchewan, and perhaps Manitoba, be sound, no company would undertake any large pipeline construction without an assurance that the Government of Alberta would allow the export of gas over a long period of years. It is by no means certain that such an assurance would be forthcoming. The present policy of the Alberta Government is to control the export of gas from the Province by a system of yearly licences. Even should proven reserves in Alberta rise substantially, it is possible that the Government would discourage the export of gas in the hope of attracting chemical industries to the Province, while at the same time offering some protection to the coal industry in the Province.

Even without any restriction on the export of gas from Alberta, unless reserves are found to be very large indeed it may happen that new chemical industries in the Province will be able to outbid potential consumers in Saskatchewan and Manitoba for such gas as may be available. In the chapter Products and By-Products the nature of chemical industries based on coal, petroleum and natural gas, and the prospects for the establishment of such industries in western Canada, are discussed. The range of such industries is enormous and at the present time natural gas may well be a cheaper material from which to start than either petroleum or coal. Synthetic liquid fuel plants alone could conceivably use more natural gas annually than is at present produced in the whole of Alberta.

PEAT

Peat has never been important as a source of energy in Canada. Annual peat production for fuel purposes has never exceeded a few thousand tons and, although the production may have been locally important, in comparison with Canada's energy requirements it has been insignificant. However, Canada has substantial peat resources and every time that a fuel shortage has threatened attention has turned to peat as a possible substitute fuel. Thus the fuel shortage of 1917 led to the appointment early in 1918 of a Joint Peat Committee*, financed

* This Committee reported in 1925 after having made a thorough study of the problem, and anyone particularly interested in peat is referred to the Final Report of the Peat Committee by B. F. Haanel, Honorary Secretary and Member Peat Committee, 1925.

equally by the Federal Government and the Government of Ontario, to conduct an investigation concerning ways and means of converting the peat content of Canadian bogs into a marketable fuel. During the recent war the Emergency Coal Production Board made further efforts to stimulate peat production. Therefore, no survey of energy sources can be complete unless some consideration is given to the possibilities of peat fuel.

Peat is the name given to the material produced by the incomplete decomposition of vegetable matter either in water or in the presence of water under such conditions that atmospheric oxygen is excluded. An accumulation of such material is called a peat bog. The absence of oxygen during the process of decomposition results in the carbonization, called humification, of the plant material. Generally speaking, the degree of humification increases from the top to the bottom of the bog. The more or less unhumified peat is known as peat moss and is used for a number of non-fuel purposes. It is from the humified peat that peat fuel is produced, and it is, therefore, with humified peat that this survey is concerned.

In respect of its physical properties, peat is exceedingly variable. The colour ranges from yellowish brown through various shades of brown to jet black. Most bogs contain more or less fibrous material. They also often contain varying amounts and forms of mineral matter which may affect their value as sources of fuel. Peat has a great capacity for taking up and holding water. Most bogs contain 90 per cent or more moisture, and even a well-drained bog ordinarily has a water content of more than 85 per cent.

The chemical composition of peat also varies widely from bog to bog. The composition of typical Canadian peat on a dry basis is said to be some 60 per cent carbon, 6 per cent hydrogen and 34 per cent oxygen. The large content of oxygen is mainly responsible for the low heating value of the substance.

The calorific value of dry peat from Canadian bogs varies usually from 8,000 to 9,500 B.t.u. per pound. It is extremely difficult to remove commercially all the moisture from peat, and so the product normally contains 25 per cent to 30 per cent water. The moisture present reduces the calorific value of the dry substance, both by displacing combustible material and by absorbing heat in evaporating during combustion. Peat that would yield 9,500 B.t.u. when dry has a calorific value of 6,795 B.t.u. with 25 per cent moisture and 6,260 B.t.u. with 30 per cent moisture.

Peat has many advantages as a fuel. Because it is easy to kindle, burns freely with a cheerful yellow flame, is hot, does not clinker and burns to a very light clean ash, it is considered to be excellent for open grates and cook stoves. But it also has disadvantages. It is about 50 per cent bulkier for weight than coal and thus requires greater storage space and more handling. Its calorific value is much lower than that for anthracite or bituminous coal and, since it burns extremely freely, peat fires must be renewed frequently. It is, therefore, not a good furnace fuel for severe weather, and it requires special burning equipment if it is to be used successfully for steam raising. In most respects peat is more comparable with wood fuel than with coal, and it is as a substitute for wood rather than coal that peat is currently regarded. Theoretically, one ton of anthracite coal is the equivalent of two tons of peat, but for open fireplaces and domestic ranges the relative value of peat is somewhat greater. A comparison with wood fuel from the heating value standpoint is difficult because of the wide variation in the heating value of different woods. One ton of peat would be more than equivalent to one cord of poor softwood and less than equivalent to one cord of good hardwood.

Only rarely does the annual Canadian consumption of peat as a fuel appear to have amounted to more than a few hundred tons. During, and for a few years after, the operation of the Peat Committee, peat fuel was shipped in

limited quantities to Ottawa and Montreal, where it was used for domestic heating in open grates, stoves, and, in spring and fall, in furnaces. For a while during the recent war small amounts of peat were used in Quebec city. For the most part, however, consumption seems to have been limited to the immediate vicinity of a few bogs in Ontario and Quebec where it was used as a substitute for wood fuel for domestic heating purposes.

Canada's peat resources were estimated by the Peat Committee to be nearly 35 billion tons but the figure was recognized to mean very little for most of the bogs occur either in unsettled areas or in areas where preferred alternative fuels are readily available. The Federal Department of Mines had investigated a number of the more important peat deposits convenient to centres of population and favourably situated as regards transportation, and its findings are given in the Peat Committee's Report and are summarized below:

No. of bogs Investigated	—	Estimated Peat Fuel with 25 per cent Moisture
		Tons
46	Ontario	112,153,000
27	Quebec	76,137,000
27	Maritimes	8,073,000
7	Manitoba	1,863,000
107		198,226,000

It is the presence of peat bogs in Ontario and Quebec, the large fuel-importing provinces, which has led to periodic efforts to develop peat production.

The major problem in peat production is that of reducing the moisture content to below 30 per cent. The removal of moisture by pressure, by artificial drying, and by air-drying have all been tried either here or in Europe, and Canadian experience indicates that air-drying is the most economic process at the present time. The disadvantage of air-drying is that the fuel must be laid out in the sun for some weeks, which requires a good deal of handling. Since the peat as dug is mostly water, 7 or 8 tons of it must be dug and handled to produce one ton of 25 per cent moisture fuel. The only other processing necessary is that of mixing and pulping, called maceration, of the raw peat. The operation increases the density and the ability to resist deterioration in handling of the dried peat, and it also reduces the effect of rains during the drying process. It is impossible to produce peat during the winter months; in Canada, experience has shown that the working season is only some 100 days. Mainly for these reasons, although probably well over 50 attempts had been made, and although the Federal Department of Mines had studied since 1908 the application of European methods to Canadian bogs, by 1918 no peat fuel industry had developed in Canada.

From 1918 to 1922 the Peat Committee conducted experiments on the Alfred bog in Ontario and by the end of 1922 had developed a production technique which offered some promise of success. In 1924 a company, Peat Fuels Limited, took over the assets of the Peat Committee and operated intermittently until 1928, but its operations resulted in marketing only 1,850 tons of peat fuel. During the 'thirties only small amounts of peat fuel were produced intermittently for local consumption from various bogs in Ontario and Quebec. During 1943 local wood fuel shortages revived interest in peat production and the

Emergency Coal Production Board contributed $62,500 for experimental operations in Quebec and Ontario, but the 1943 production of peat was only 1,500 tons in Quebec and 250 in Ontario.

The history of the peat production in Canada gives little grounds for believing that peat is likely to become an important source of energy in the foreseeable future. It may achieve local importance as a substitute for wood fuel, but its contribution towards meeting our energy requirements is likely for some years to be insignificant.

ATOMIC ENERGY

Since the bombing of Hiroshima on August 6, 1945, there has been a good deal of speculation about the peacetime implications of atomic energy. In a review of sources of energy, it seemed to us necessary to say something about these implications, particularly insofar as they affect coal. We therefore asked Dr. C. J. Mackenzie, President of the National Research Council, for his opinion as to the effects which the development of atomic energy may have on the use of coal as a source of energy. We asked him to be as specific as he could be regarding the time within which various uses of atomic energy might develop and the fields in which it might be used. Dr. Mackenzie's reply, received in October, 1946, is presented in full.

"The first thing that must be realized is that any opinion at present is of necessity more in the nature of a guess than a precise estimate because of the uncertainties surrounding the future of atomic energy. At the present time we know very little of the precise form future developments will take, how long it will take to make such developments, or what the cost will be, and all one can give is a consensus of opinion of a number of scientists and engineers who have been closely associated with the project. However, I must emphasize that individual opinions, particularly as to time and costs, vary widely within the group consulted.

"The time of developments will be directly influenced by the amount of money and effort which the nations of the world will be prepared to devote to the work in peacetime. It will also be affected by security restrictions. The only experience we have had in development work in this field has been under the abnormal conditions of war, and if that scale of effort were maintained, which is extremely unlikely, the time taken to make developments would be relatively short. On the other hand, if the effort allotted to developments is not greater than in pre-war years, the progress will probably be very slow. The true answer is to be found somewhere between these two extremes but it cannot be expressed in a definite figure.

"Again as to costs, when one talks about competitive cost figures, it can be seen that it depends again on the attitude of governments. If they support work in this field as they did in war and bear a high cost of development charges, the cost to consumers of any product would obviously be less than if private industries had to carry the development costs and added such costs to the final price; all of which makes for uncertainties in cost estimates.

"What future developments will actually take place is another factor of uncertainty, and it is well known that new scientific findings and developments often affect the time and cost of materials. Taking all these things into consideration and with a full knowledge of the danger of making estimates, I would suggest the following prediction as to what might be the situation within the various time intervals suggested by you.

"*Five Years*

No industrial use of atomic power, except on a pilot plant scale for purely experimental purposes.

"*Ten Years*

Limited use under special circumstances, where cost is not a consideration. Examples are: military uses; rockets to the moon; very long-range aircraft; naval uses to give effectively unlimited cruising range; supply of power in remote areas such as the far north.

"*Fifteen Years*

Considerable decrease in costs. Industrial uses beginning to develop. Price probably still high enough so that effect on coal is negligible.

"*Twenty Years*

Possibly costs beginning to approximate coal or hydro-electric power. New uses may very well lead to increased power consumption, and hence unlikely to decrease coal consumption.

"Regarding fields of use, the following suggestions are made under the categories suggested by you:

1. *Railways*: Might be ultimately attractive for railways but more probably through the medium of electrification.

2. *Manufacture of Electricity:* It is improbable that the cost will ever fall below that of a good hydro-electric development at least until the annihilation of matter becomes feasible. Also it should be remembered that distribution costs will still remain the major cost.

3. *Other Industrial Uses:* These will probably be many, but the majority will probably be new processes, and hence not really competing with coal.

4. *Domestic Use, including central heating:* Domestic uses, other than central heating, are unlikely. Central heating is, of course, merely a question of costs. In my opinion, for low-grade uses of power, such as heat, it is unlikely to be economical in the next twenty years.

5. *Ships' Bunkerage:* Here increased pay-load is a factor favouring atomic power. In the future this may well be one of the first widespread uses. But there probably will be no displacement of coal to any appreciable extent within twenty years. It may be noted that the cost of converting ships would probably be high so that when this use does come into play, it may be uneconomic except for new ships.

"In my opinion, the coal industry has nothing to fear in the next ten years, and very little in the next twenty. I do not think any more detailed estimate of costs can be given which has any meaning."

CHAPTER IX

MARKETS

The purpose of this chapter is to review the market for coal in Canada, indicating how much coal is used, what kind of coal it is, and by whom and for what purpose it is used. An attempt has been made to examine any trends in the market that are considered to be of importance.

As is so often the case with Canadian affairs, the analysis of the coal market in Canada can best be handled if it is approached on a regional basis. For this reason we have attempted not one review but four—one for the Maritime Provinces, one for Ontario and Quebec, one for the Prairie Provinces and one for British Columbia. In each case the movement of coal from one region into another has been dealt with in the region in which it was consumed. Coal exported to other countries has been dealt with in the region in which it was produced.

The general method has been to examine, one region at a time, the use of coal for domestic purposes, by industry, by coke and gas plants, by railroads and for ships' bunkering. In order to achieve this treatment, a considerable amount of preliminary work of a statistical nature was required. Fortunately, in recent years the Dominion Bureau of Statistics has collected for the use of the Office of the Coal Controller a great deal of information on the coal consumption in Canada. This material has been made available to the Commission and from it tables of coal consumption by region, by source and kind of coal, and by type of consumer, have been prepared. Those tables, with explanatory notes, are presented in Appendix D. This Chapter has been planned to be read without reference to those tables, but attention is called to them because they are the immediate source of most of the figures used in the chapter and because they may be of assistance as reference material to anyone who wishes to pursue market analysis in a different way or to carry it further.

The statistics available on coal consumption do not show separately the use of coal for domestic purposes, that is, its use in dwellings for cooking, water heating and space heating. They do, however, show separately retail sales of coal, that is, all sales of coal at retail prices. The great bulk of coal sold at retail prices is used for domestic heating purposes, and in this chapter figures on retail sales are used as though they were figures on domestic consumption. This procedure involves some error, for retail sales include sales to small commercial and industrial establishments for uses not properly referred to as domestic.

Throughout the following sections no overall forecasts of coal consumption are made. There are a few attempts to forecast the coal requirements for some specific purposes, but such attempts are the exception rather than the rule. The reason for the absence of general forecasts is, of course, that prophesying about coal consumption is a very hazardous thing to do. Over the past twenty years coal consumption has fluctuated within wide limits and it is by no means certain that it will not continue to do so. In the preceding chapter the relationship between coal consumption and the level of industrial activity over the past two decades was examined. The closeness of that relationship makes it clear that a forecast of coal consumption is, in effect, a forecast of the level of industrial activity, a forecast we are not equipped to undertake.

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THE MARITIME MARKET

In this section the market for coal in the provinces of New Brunswick, Nova Scotia and Prince Edward Island will be examined. Because of special problems peculiar to the marketing of coal mined in New Brunswick, there follows at the end of the general discussion a special examination of the market for New Brunswick coal.

The Maritime area relies more heavily on coal for its energy than does any other of the areas into which Canada has been divided for purposes of market analysis. It is estimated that in recent years coal supplied nearly three-quarters of the energy obtained from all sources, with the other quarter coming in more or less equal amounts from water power, petroleum and wood fuel. This general statement should be qualified by noting that the relative importance of petroleum increased considerably during the war years, mainly at the expense of coal. There is some natural gas used in Moncton and vicinity but the amounts are so small that they are almost insignificant in the over-all energy picture.

Production

The Maritime region is one of the principal coal-producing areas in Canada, with an annual output in the neighbourhood of 7,000,000 tons. The coal produced is almost all high volatile bituminous. The bulk of the production is on Cape Breton Island but there are important producing areas on the mainland of Nova Scotia in Cumberland County and Pictou County and in New Brunswick in the area around Minto.

COAL CONSUMPTION IN THE MARITIMES

(In net tons)

—	1937	1939	1940	1943
Retail Sales	1,148,000	1,179,000	1,324,000	1,403,000
Industry, including coke and gas plants	2,142,000	1,878,000	2,326,000	2,498,000
Railways	729,000	679,000	917,000	1,339,000
Bunkers	387,000	426,000	530,000	600,000
Total	4,406,000	4,162,000	5,097,000	5,840,000

The Retail Market

According to the 1941 Housing Census, the principal fuel for domestic heating in each province of the Maritimes was wood, which was used in 61 per cent of all Maritime dwellings. Coal and coke were the heating fuels used in only 37 per cent of Maritime dwellings. The use of wood was concentrated in the rural areas, with coal predominant in the urban areas. Relatively small amounts of fuel oil, and in New Brunswick some gas, were also used.

The following table gives a summary of retail sales of coal and coke in the Maritimes. The figures include sales of coal and coke by collieries to their employees and others for domestic use.

RETAIL SALES OF COAL AND COKE IN THE MARITIMES

(In net tons)

—	1937	1939	1940	1943
Anthracite	142,000	136,000	137,000	141,000
Other Coal	1,006,000	1,043,000	1,187,000	1,262,000
of which Imported	*51,000*	*40,000*	*37,000*	*12,000*
Coke	60,000	54,000	63,000	95,000
Total	1,208,000	1,233,000	1,387,000	1,498,000

Speaking generally, the coals produced in the Maritimes are not entirely suitable for use in hand-fired natural-draft domestic heating equipment. Although there is some medium volatile coal produced locally, most of the production is high volatile which, in the process of combustion, produces a considerable volume of volatile gases. Unless particular care is taken in the firing of hand-fired natural-draft equipment, the volatile gases produced will not be completely burned in the combustion chamber and a good deal of smoke and soot will result. It is this disadvantage of the local coals that accounts for the use of anthracite and imported bituminous by householders in the Maritimes. In total, the consumption of these imported domestic fuels was about 175,000 tons annually in the pre-war years, of which more than one-half was United Kingdom anthracite. The imported fuels were more expensive than local coals and the use of them was therefore restricted to those willing and able to pay a premium in order to enjoy the benefits of their superior burning characteristics.

Before the war the retail sales of Canadian bituminous coal were about 900,000 to 1,000,000 tons per year, of which approximately three-quarters were sold in Nova Scotia. About three-quarters of the Canadian bituminous sales were of sizes suitable for natural-draft equipment. Nearly all of the mines operating in the Maritimes delivered some coal to the retail market, but the variation in suitability of the output of the various mines for domestic use has resulted in some producers capturing much more than a proportionate share of that market. This appears to have been particularly true of the Springhill operation in Cumberland County and Old Sydney Collieries in Cape Breton, the output of the former being preferred because of its lower volatility and somewhat higher ash fusion temperature and that of the latter because of a lower ash content and a firmer structure than other Nova Scotia coals.

The disadvantages of a high volatile coal for domestic use are overcome by the use of underfeed stokers. There is in the Maritimes a considerable market for stoker coal and several operators have been specially sizing and at least one has been oil treating fuel for domestic stoker use.

Coke is a relatively unimportant domestic fuel in the Maritimes; in pre-war years only about 60,000 tons were consumed annually, most of it in Nova Scotia. Practically all the coke used was made from Canadian coal. The main source of the coke sold retail is the Dominion Steel & Coal Corporation plant at Sydney, although small tonnages come from the Nova Scotia Light and Power Company plant at Halifax and the New Brunswick Power Company plant at Saint John. Although the Dominion Fuel Act of 1927 was intended to encourage the construction of coke and gas plants in Ontario and Quebec rather than the Maritimes, the Halifax plant qualified under it and to the end of 1944 had received federal assistance to the extent of $117,000.

The Industrial and Coke and Gas Markets

The following table gives the consumption of coal by industry in the Maritimes:

COAL CONSUMPTION BY INDUSTRY IN THE MARITIMES INCLUDING USE IN COKE AND GAS PLANTS

(In net tons)

—	1937	1939	1940	1943
United Kingdom anthracite	1,000	1,000	1,000	Nil
United States bituminous	2,000	2,000	2,000	22,000
Canadian bituminous	2,139,000	1,875,000	2,323,000	2,476,000
of which used in coke and gas plants	*700,000*	*644,000*	*927,000*	*856,000*
Total	2,142,000	1,878,000	2,326,000	2,498,000

From the above figures it is clear that there is no significant use of imported coal by Maritime industry.

In order to indicate the relative importance of various industrial consumers, the following approximate breakdown of the industrial totals for 1937 and 1943 is presented:

—	1937	1943
	Net Tons	Net Tons
Use of coal in iron and steel industry by Dominion Steel and Coal Corp. and affiliates	875,000	1,220,000
Colliery use, excluding deliveries to colliery employees	400,000	315,000
Central electric station industry	215,000	300,000
Wood and paper industry	345,000	405,000
Other industrial use	307,000	258,000
Total industrial use of coal	2,142,000	2,498,000

The iron and steel industry is by far the largest industrial consumer of coal in the Maritimes. The major operations in that industry are those of Dominion Steel and Coal Corporation Limited, and over a number of years the steel operations of that corporation have used about 20 per cent of the coal produced by mines affiliated with it. The steel industry generally is very vulnerable to the cycle of economic prosperity and depression, and the Nova Scotia industry is no exception. The coal requirements of the Dominion Steel and Coal Corporation's steel operations have varied from about 160,000 net tons in 1932 to 1,325,000 tons in 1942. The pronounced instability of so important a market constitutes one of the most serious marketing problems of the Nova Scotia coal industry.

About four-fifths of the coal used by the Sydney Steel Plant is slack, the remainder being screened lump and run-of-mine. The slack is used chiefly for making metallurgical coke, the screened coal for gas production for open-hearth furnaces, and the run-of-mine coal for general steam raising purposes. It was the availability of large quantities of slack at low prices that led to the establishment of the steel plant at Sydney in 1899. The outlet provided by the steel plant since that time for enormous quantities of slack has been of tremendous importance to the coal operation, for the slack would otherwise have been extremely difficult to market. In addition, the steel plant provided an all-year-round market for coal, which is important in view of the suspension of water-borne shipments during winter months.

The second largest outlet for coal is the operation of the collieries themselves. Normally, the Maritime collieries use between 300,000 tons and 400,000 tons annually, most of it under boilers. In Nova Scotia, and particularly in Cape Breton, a substantial portion of the steam raised in collieries is used for the generation of electricity. The Dominion Steel and Coal Corporation owns and operates over 70,000 kilowatts of generating capacity in the Cape Breton and New Glasgow areas, of which about 85 per cent of the net output is used in the coal and steel operations of the Corporation. Most of the electricity generating plants owned by the Corporation have been designed to use slack, which would otherwise be without a ready market, and the outlet thus provided for upwards of 150,000 tons per year makes an important contribution to the over-all efficiency of the mining operations.

In addition to coal used by companies for the generation of electricity for their own purposes, the central electric station industry in the Maritimes uses 200,000 tons or more annually for the generation of electricity for public sale. The main source of central electric station electricity in the Maritimes is water power; in fact, in 1943 only 35 per cent of the total central station output in Nova Scotia, and 22 per cent in New Brunswick was thermally generated. The water power resources of the Maritime Provinces are, however, limited. The recent report by H. G. Acres and Company to the Federal Department of Mines

and Resources on the possibility of using tidal power in the Petitcodiac and Memramcook estuaries, indicates that that source of energy is not likely to be of practical importance. Prince Edward Island is, of course, too small to have any rivers suitable for hydro developments. The rivers of Nova Scotia do not provide either sufficient head or a sufficient volume of controllable flow to make any further hydro developments in that province very attractive. In New Brunswick the water power possibilities of the St. John River and its tributaries are by no means exhausted, but further use of them will depend primarily on successful action being taken to control the flow in that drainage system. It so happens that the areas in which control measures must be taken are mainly in the State of Maine and in the Province of Quebec, making interprovincial and international agreements necessary before adequate action to that end can be undertaken. The New Brunswick Natural Resources Development Board is pressing for such action in the belief that only by developing her water power resources can New Brunswick obtain the large sources of cheap electricity which she needs so badly. However, it is by no means certain that all the required expansion of electricity output will be obtained from water power developments, and it appears probable that the central electric station demand for coal in that province will continue to expand.

The only other important industrial user of coal in the Maritimes is the wood and paper industry, which uses upwards of 350,000 tons annually, mainly in pulp and paper plants. This industry provides an inportant outlet for both New Brunswick and Nova Scotia coal.

The Railway Market

In pre-war years bituminous coal requirements of all railways in the Maritimes ran at about 700,000 tons per annum. The Maritime requirements amounted to about 10 per cent of total railway requirements in Canada. Normally, no significant amounts of imported coal were used by railways in the area.

The following table gives details of railway uses of bituminous coal for the various years:

BITUMINOUS COAL CONSUMPTION OF ALL RAILWAYS IN THE MARITIMES

(In net tons)

—	1930	1933	1937	1940	1943
Canadian coal	808,000	574,000	728,000	916,000	1,282,000
Imported coal	32,000	Nil	1,000	1,000	57,000
Total	840,000	574,000	729,000	917,000	1,339,000

The Canadian National Railways is, of course, the principal coal consuming railway in the Maritimes, its requirements amounting to about 75 per cent of total railway requirements. Over the four-year period, 1936 to 1939 inclusive, the Canadian National Railways used on the average about 400,000 tons of Nova Scotia coal and about 125,000 tons of New Brunswick coal per year. Since most Maritime mines are located on or near Canadian National Railway lines, the coal is normally moved by rail to the point at which it is required. The Canadian Pacific Railway Company operates only about 25 per cent of the Maritime railway mileage, and therefore its coal requirements are much smaller than those of the Canadian National Railways. In the years 1936 to 1939 inclusive, the Company purchased just under 90,000 tons per year, of which substantially less then one-half was New Brunswick coal. Coal mined at Springhill, Nova Scotia, is used on the Dominion Atlantic Railway, a Canadian

Pacific Railway Company subsidiary. Coal mined at Minto is used exclusively on the Company's branch lines in New Brunswick, but due to its relatively low B.t.u. value and high ash content it has been found impossible to use it in main line heavy traffic operations. Therefore, the general practice has been to use Sydney coal for Canadian Pacific Railway Company main line operations in New Brunswick between Saint John and McAdam.

The Bunker Market

At one time the bunker market was of considerable importance, but in recent years it has suffered severely from competition by oil. In 1939 coal deliveries to ships' bunkers totalled 426,000 tons, while in the same year oil deliveries amounted to the equivalent of about 450,000 tons. There is a limited amount of United States and United Kingdom coal imported for bunkerage but for all practical purposes bunkerage needs are met by Cape Breton production.

The Maritime bunker market is a very uncertain one, subject to very severe contractions when ocean-borne trade declines. Not only are there then fewer ships at sea, but those at sea tend to have less than a full cargo of revenue freight and take on bunker coal to maximum capacity at ports where the lowest price prevails. Because of the high cost of production of Maritime coal, Maritime ports are not low price ports.

Despite some recent successes in improving the efficiency of coal-burning marine power equipment, it is anticipated that coal will have, in the next few years, no relief from the pressure of oil in the bunker market.

The Export Market

Over the past two decades the export market for Canadian coal from the Maritimes has been quite unstable. In 1930 exports ran at about 375,000 tons; in 1932 they fell to about 160,000 tons; in 1935 they reached nearly 300,000; and in the three pre-war years they were about 200,000. Under the impact of war they rose to over 500,000 tons per year.

The two principal destinations of exported coal have been Newfoundland and the United States. Since the end of World War I, Newfoundland has normally imported approximately 300,000 tons of coal per year from all sources, although the year to year figures have fluctuated from about 220,000 tons to about 400,000 tons. The three major suppliers of this tonnage have been Canada, the United Kingdom and the United States, with the share of the market that each enjoyed changing very substantially from year to year. In the period around 1920, Canadian bituminous exporters enjoyed almost the whole of the Newfoundland market; throughout the 1920's they held about two-thirds of that market; and from 1930 on their share fell steadily until in the pre-war years they supplied just over one-third of the coal imported by Newfoundland. The situation was greatly disturbed during World War II for Newfoundland became an important base for United Nations operations of various kinds; thus, although exports of coal from Canada to Newfoundland expanded considerably during war years, little significance can be attached to the fact.

The instability of this market for Canadian coal is due mainly to the keen competition experienced from United Kingdom coal. The United Kingdom imports a large proportion of the pulp and paper production of Newfoundland and the returning ships carry coal to Newfoundland at very favourable ocean rates. Although the steel industry in Nova Scotia secures its ore from Newfoundland, technical shipping considerations preclude the use of ships built for the ore-carrying trade from taking coal to Newfoundland.

The United States market for Maritime coal has, over the last twenty years, been in the neighbourhood of 100,000 tons annually. Since 1938 this amount has been divided between New Brunswick and Nova Scotia producers, the former exporting in the neighbourhood of 30,000 tons a year. Practically all of this coal is absorbed by paper companies of the Maine-New Brunswick border.

At one time the Nova Scotia producer enjoyed a considerable market in New England. For example, in 1902 the Dominion Coal Company had a five-year contract for the delivery of 540,000 tons annually to Everett, Massachusetts. By 1913 exports to the United States had fallen to 258,000, and during World War I the United States market for Nova Scotia coal disappeared. For more than twenty-five years the New England States have been supplied from United States sources, despite the fact that since 1934 Canadian coal has been permitted to enter United States duty free. In the light of the recent history of production costs in Nova Scotia, there is no reason to believe that the Nova Scotia producer can recapture any part of the New England market.

THE MARKET FOR NEW BRUNSWICK COAL

Production in New Brunswick

From the middle '20's to the end of 1933 output of New Brunswick mines was fairly steady at about, and usually just over, 200,000 tons. In 1933, it rose sharply to 312,000 tons, and it fluctuated between 315,000 tons and 370,000 tons up to the end of 1938. In 1939 it again rose sharply to 468,000 tons and reached the maximum ever achieved in 1940 with 547,000 tons. Production fell off slowly in 1941 and then rapidly until in 1944 only 345,000 tons were mined.

Most New Brunswick coal is classified as high volatile "A" bituminous and as such is comparable in rank with most Nova Scotia coal. In grade, however, it is much inferior, containing more ash, more sulphur and, as received, more moisture than almost all Nova Scotia coal.

The Market in New Brunswick

New Brunswick is the natural market for the output of New Brunswick mines, and over the past ten years it has always absorbed at least 85 per cent, and usually more, of New Brunswick production. Even so, since 1935 New Brunswick mines have never supplied more than 40 per cent of the province's coal requirements. Nova Scotia is the principal external source of coal used in New Brunswick, and amounts received from that source have always exceeded local production, usually by a wide margin. In addition, coal is imported from the United Kingdom and the United States. In the immediate pre-war years about 75,000 tons per year were received from Britain, and some 30,000 tons per year from the United States. Most of the coal received from both the latter sources was anthracite.

It is impossible to find any one pre-war year which is truly typical, insofar as the disposition of New Brunswick coal is concerned, for the demand for the product was changing rapidly in that period. As a basis for discussion, however, the following approximate breakdown of the use of New Brunswick coal in New Brunswick for 1939 is presented:

—	Net Tons	Percentage of all N.B. Coal used in N.B.
Purchased by railways	179,000	46
Purchased by pulp and paper industry	130,000*	33
Consumed in Grand Lake Plant of N.B. Electric Power Commission	27,000	7
Domestic and Commercial use	25,000*	6
Residual—mainly miscellaneous industrial use	31,000	8
Total	392,000	100

*Estimate.

The railways have normally been the largest consumers of New Brunswick coal. In the years before the war they took almost one-half of the New Brunswick production, which met just under one-half of their total coal requirements in the province. However, despite their increasing coal needs, since 1940 the railways have used less New Brunswick coal, until by 1943, of all coal used by the railways in New Brunswick only 14 per cent was New Brunswick coal, constituting only 28 per cent of total New Brunswick production. The chief reason for the declining railway use of New Brunswick coal has been that lump coal, which the railways normally consume, has not been available. It is significant, however, that the price differential in favour of New Brunswick coal as against Nova Scotia coal, which has previously induced the railways to use the former coal, has largely disappeared. It is, therefore, by no means certain that the railway market can be regained as and when lump coal becomes again available.

By far the largest industrial coal consumer in New Brunswick is the pulp and paper industry. Since 1940 the coal requirements of that industry have exceeded 300,000 tons per year, of which upwards of 120,000 tons has been New Brunswick coal. Much of the New Brunswick pulp and paper industry is centred around the Bay of Chaleur, an area in which the local coal received very little freight protection from Nova Scotia coal and in which, therefore, competition with Nova Scotia coal has always been very keen. The decreasing price differential between New Brunswick coal and Nova Scotia coal, previously referred to, will tend, therefore, to make this outlet very difficult to hold.

The third largest customer of the New Brunswick mines has been the New Brunswick Electric Power Commission. The chief generating plant of that Commission, and the largest fuel plant in the province, is the Grand Lake Plant of 20,000 k.w. capacity. This plant has been specially designed to burn Minto slack coal. Since 1939 its consumption has increased rapidly to about 80,000 tons in 1944. In 1944 the Grand Lake Plant provided more than 80 per cent of the electricity requirements of the Commission's system. The New Brunswick Electric Power Commission is at present constructing a thermal generating station at Chatham, New Brunswick, which is also designed to burn Minto slack coal. This unit will have a capacity of 12,500 k.w., and provision is being made to duplicate the unit in the future, should the demand for electricity warrant it. If this plant does in fact use Minto coal, it will increase very substantially the Commission's coal requirements. However, the plant is so located that it has fairly good access to Nova Scotia coal, and it will presumably use that product if the economics of the situation are definitely in its favour.

The New Brunswick producers have never been able to develop any very substantial domestic and/or commercial market. In part, this is due to the fact that about 75 per cent of the dwellings in the province are heated principally by wood fuel; in part because Minto coal is not a particularly satisfactory domestic fuel, and even those who burn coal prefer either anthracite or Nova Scotia bituminous. The Minto coal that has been sold in this market has been used mainly in hospitals and public buildings for steam raising. It can be used with good results in furnaces having proper stoking facilities, but due to the limited use of coal for domestic heating purposes, there does not appear to be much prospect of any substantial domestic market for stoker coal being developed. The introduction on a large scale of newly developed bituminous coal-burning heaters would increase somewhat the domestic use of Minto coal, providing, of course, that the price was competitive.

In addition to the markets discussed above, there exists a miscellaneous industrial market for Minto coal, located largely in the area around Saint John. This market is at best not large and, even should it be supplied completely by the New Brunswick product, it could not absorb a very large percentage of the output maintained in recent years.

The Market Outside of New Brunswick

Although the shipments of New Brunswick coal out of New Brunswick have never exceeded 15 per cent of her total production, and have usually been substantially less, there has been on occasion a fairly important market for it both in Quebec and in the State of Maine.

Shipments to Quebec have been possible only with the aid of Federal subvention payments. Such shipments rose from 14,000 tons in 1935 to 54,000 tons in 1940. Since that time, however, the Quebec market has been lost to New Brunswick coal, and by 1943 only 6,000 tons of Minto coal were moved into Quebec.

Since 1938 there has existed a fairly suitable market for about 30,000 tons per year of New Brunswick coal in Maine. This coal has been used chiefly by pulp and paper plants, and has been mostly slack coal. Despite the limited size of the outlet, it constitutes a very substantial percentage of the total market for Minto slack coal.

Summary

The principal competition to New Brunswick coal in the Maritime market comes from Nova Scotia coal, and the indications are that since 1939 the competitive position of New Brunswick coal producers in that market has deteriorated appreciably. Because New Brunswick coal, while approximately equal in rank, is inferior in grade and therefore in heating value to most Nova Scotia coal, coal users can be induced to use it only if its cost per ton to them is sufficiently less to compensate for its disadvantages. In pre-war years the cost differential in favour of New Brunswick producers was in most cases significantly larger than it was at the war's end. Until the New Brunswick industry improves substantially its position relative to its competitors in Nova Scotia, the market in the Maritimes for New Brunswick coal will be seriously restricted.

CENTRAL CANADIAN MARKET

In this section will be discussed the market for coal in Quebec and Ontario. The two provinces will be referred to together as Central Canada.

According to estimates made for 1937 and 1943, about one-half of the energy obtained from all sources in Central Canada was obtained from coal. The relative importance of coal in this area is much less than in the Maritimes, about the same as on the Prairies and much greater than in British Columbia. The most important alternative source of energy in Central Canada is water power, from which about one-third of all the energy used was obtained. Only in British Columbia is the reliance of this area on water power equalled. The remainder of the energy has been obtained from petroleum and wood fuel, with the former having been rather more important than the latter. Although the relative position of petroleum has declined during the war years, due principally to difficulties in supply, its importance is expected to increase considerably during the next decade. The use of wood fuel and its probable future importance are discussed below in the section on the retail market. Some natural gas is consumed in southwestern Ontario. Although the importance of this fuel is great in that area, it is very small in the over-all picture.

Production

There is normally no production of coal in either Quebec or Ontario. Seventy miles south of James Bay there are peat-like deposits classified under the A.S.T.M. classification as lignite, but the coal is of such inferior quality that the only production there has been experimental and insignificant in amount.

Consumption Estimates

The following table presents estimates of coal consumption in Central Canada by type of consumer for some recent years.

CONSUMPTION OF COAL IN CENTRAL CANADA

(In net tons)

—	1937	1939	1940	1943
Retail	5,838,000	6,303,000	6,113,000	8,350,000
Industrial	5,311,000	5,031,000	5,573,000	8,255,000
Coke and Gas Plants	2,595,000	2,394,000	2,962,000	3,610,000
Railways	4,162,000	4,189,000	4,830,000	7,463,000
Bunkers	521,000	528,000	520,000	535,000
Total	18,427,000	18,445,000	19,998,000	28,213,000

Quebec and Ontario consume more coal than all the rest of Canada. To illustrate the individual and also the combined importance of these two provinces, the following table is presented. In order to allow a wider selection of years and to show the provincial totals separately, the figures below are estimates of coal available for consumption rather than actual consumption.

COAL AVAILABLE FOR CONSUMPTION

(In net tons)

Year	Ontario	Quebec	Ontario and Quebec	Canada
1929	15,400,000	5,200,000*	20,600,000	35,300,000
1933	8,800,000	4,400,000*	13,200,000	23,100,000
1937	14,200,000	5,000,000	19,200,000	31,500,000
1939	12,200,000	5,000,000	17,200,000	29,200,000
1943	19,500,000	8,700,000	28,200,000	45,600,000

*Includes an unknown but considerable tonnage shipped to Ontario.

These figures indicate that Ontario uses from two-thirds to three-quarters of the coal used in Central Canada and about two-fifths of that used in all of Canada.

Apart from its size the outstanding feature of the Central Canadian market is the extent to which it is supplied by foreign sources, particularly the United States. The relative importance of the various sources for 1937 and 1943 is shown below.

—	1937	1943
	Per cent	Per cent
United States	71	93
United Kingdom	6	2
Other foreign	3	Nil
Total imported	80	95
Canada	20	5

The Retail Market

The Housing Census of 1941 revealed that of all the occupied dwellings in Ontario and Quebec in that year, 53 per cent were heated principally by coal and coke, 41 per cent by wood fuel and 3 per cent by each of fuel oil and gas.

The importance of wood fuel in the domestic heating market in Central Canada is much greater than is generally realized. In both provinces, particularly in Quebec, the use of wood fuel is concentrated in rural areas where it is used to a very much greater extent than all other fuels combined. Unfortunately, statistics of wood fuel consumption are not very satisfactory. However, the Dominion Bureau of Statistics figures indicate that in 1940 5,300,000 cords of firewood were cut on farms in Ontario and Quebec. To this must be added mill-waste used as fuel, the volume of which in 1943 was at least 400,000 cords. On the basis that 1.75 cords of wood fuel are approximately equal to one ton of anthracite coal in heating value, the coal equivalent of wood fuel used in Central Canada in 1940 was probably about 3,250,000 tons. Since 1940 the use of wood fuel appears to have declined somewhat. Its future importance is difficult to predict for the cutting of wood for fuel is, to a considerable extent, a depression industry, the output falling when other work is available. However, the depletion of wood lots in the region will probably cause a long-term downward trend in the use of this fuel.

The relative importance of fuel oil for domestic heating has not hitherto been very great, although estimates for consumption suggest that the Housing Census returns underestimate the extent of its use. During the war years the consumption of fuel oil for domestic heating declined, but now that both oil and the equipment required to use it are again available, its importance is increasing rapidly. It is expected that the use of fuel oil for domestic heating will continue to expand for the next few years.

The Housing Census figures for gas include both natural and manufactured gas. The importance of each of these appears to be roughly equal. The reserves of natural gas in southwestern Ontario have been steadily declining and the use of the fuel has fallen somewhat as a result. However, arrangements recently made whereby natural gas may be imported during off-peak months from the United States pipeline network give promise that the importance of this fuel in the area will be maintained. Manufactured gas is supplied to a number of urban areas throughout the region. Details of the plants supplying it may be found in the section on the coke and gas industry.

A table presenting detailed statistics of retail sales of coal and coke in Central Canada for the years 1928 to 1932 inclusive, 1937, and 1939 to 1945 inclusive, is included in the Appendix. A summary of this table is given below. The percentages shown are of total retail sales of coal and coke in Central Canada.

RETAIL SALES OF COAL AND COKE IN CENTRAL CANADA

(In net tons)

—	1928	1932	1937	1940	1943	1945
Anthracite	3,504,000	2,967,000	3,122,000	3,263,000	4,167,000	3,173,000
Per cent	55	49	46	45	45	36
Other coal	1,756,000	1,697,000	2,716,000	2,850,000	4,183,000	3,786,000
Per cent	28	28	40	39	45	42
of which Canadian	475,000	386,000	587,000	614,000	165,000	243,000
Per cent	7	6	9	8	2	3
Coke	1,073,000	1,356,000	1,000,000	1,134,000	957,000	1,988,000
Per cent	17	23	14	16	10	22
Total coal and coke	6,333,000	6,020,000	6,838,000	7,247,000	9,307,000	8,947,000

The figures indicate that anthracite has been the main domestic fuel in Ontario and Quebec. Next in order have come bituminous and lower-rank coal and then coke. Most of the domestic coke used in the area was made in Canada, but only one of the larger suppliers, namely, Montreal Coke and Manufacturing Company, uses any appreciable quantity of Canadian coal. Even allowing for the Canadian coal content in domestic coke sales, Canadian coal over the past twenty years has not provided more than about 10 per cent of the coal and coke requirements of the retail market in Central Canada.

More than 90 per cent of the anthracite imported into Canada enters the retail trade in Ontario and Quebec. Of the remainder, approximately half enters the retail trade in the Maritimes, and the other half is used by industries in Ontario and Quebec. The use of anthracite in Western Canada is so limited that it can be ignored. Retail sales in Central Canada constitute, therefore, the great bulk of the anthracite coal trade.

The special advantages of anthracite for domestic heating are well known—it provides relatively clean, smokeless, continuous heat with a minimum of attention. In hand-fired equipment with natural draft, larger sizes of anthracite known as domestic sizes, and ranging from about $\frac{9}{16}$ inch diameter upwards, are used; in forced draft equipment, smaller sizes, known as buckwheat sizes, and ranging from about $\frac{9}{16}$ inch in diameter downwards, are used. In the early 1930's there was a strong trend towards blower-type equipment, most of it designed to burn United Kingdom buckwheat and smaller sizes. In addition to its use for domestic heating, anthracite is also used for several purposes where clean heat is particularly important, for example, in bakeries, in malting plants, and in poultry brooders.

Anthracite imports by country of origin from 1922 to 1945 inclusive are given in the following table:

TOTAL IMPORTS OF ANTHRACITE INTO CANADA BY COUNTRY OF SOURCE

(In thousands of net tons)

Calendar Year	Total Anthracite Imports	United States	United Kingdom	Russia	Germany	French Indo-China	All* Others
1922	2,694	2,514	180	......	......	......	......
1923	5,168	4,906	262	......	......	......	......
1924	4,183	3,908	275	......	......	......	......
1925	3,799	3,250	549	......	......	......	......
1926	4,243	3,883	272	......	50	......	38
1927	4,064	3,265	788	......	5	......	5
1928	3,737	3,203	526	6	......	......	1
1929	4,020	3,173	729	117	......	......	......
1930	4,256	2,956	996	291	11	......	1
1931	3,178	2,236	876	......	61	......	5
1932	3,138	1,686	1,399	......	52	......	1
1933	3,036	1,430	1,606	......	......	......	......
1934	3,537	1,804	1,644	......	72	......	18
1935	3,451	1,670	1,455	......	205	54	67
1936	3,536	1,686	1,331	......	360	97	62
1937	3,558	2,003	1,134	154	258	......	8
1938	3,724	1,977	1,199	15	411	30	91
1939	3,978	2,606	1,035	......	294	44	......
1940	3,973	2,644	1,329	......	......	......	......
1941	3,941	3,311	630	......	......	......	......
1942	4,802	4,422	380	......	......	......	......
1943	4,459	4,074	385	......	......	......	......
1944	4,413	4,195	218	......	......	......	......
1945	3,411	3,383	28	......	......	......	......

*Includes Alaska, Belgium, China, Morocco, Netherlands and Newfoundland.

Before 1922 Canada was entirely dependent on the United States for anthracite. The strike in the U.S. field in 1922 resulted in the importation in the following years of some anthracite from the United Kingdom. However, a more significant thing to be noted is the large importation from the United Kingdom commencing in 1932. This is in part explained by the imposition in that year of a duty of 50 cents per ton on United States anthracite, with anthracite from the United Kingdom remaining free under the preferential tariff policy. Large importations of anthracite from overseas continued until interfered with by war conditions. One difference between United Kingdom and United States anthracite is that the former has a lower ash fusion temperature and is therefore more suitable than the latter for use in forced-draft equipment where the removal of ash depends upon the fuel used having clinkering properties. A second difference, which explains the preference given to domestic sizes of Welsh anthracite, is that the Welsh coal has a lower ash content than the United States anthracite. German anthracite was brought into the country by the importers of United Kingdom anthracite to supplement supplies from the United Kingdom. In that German anthracite, like United Kingdom anthracite, has a low fusion temperature of ash, as compared with Pennsylvania anthracite, it is a satisfactory substitute for the United Kingdom product in forced-draft equipment. Russian anthracite is reported by the trade to be unexcelled, and, considering that in 1929 it was a new source of supply, relatively large amounts were imported in that and the following year. From 1931 until 1937 there was an embargo on the importation of this coal. It is difficult to estimate how much anthracite will be available in the future from either the United Kingdom or Russian sources. The depressed nature of the industry in the United Kingdom, and the high cost of production, may militate against its effective competition with anthracite from United States sources, and supplies available from Russia will, to a considerable measure, be dependent on the trade policies which that country adopts.

In the early 1920's there was considerable concern expressed in this country by various committees charged with investigating Canadian fuel supply over the meeting of Canada's anthracite requirements. At that time the United States was practically the sole source of anthracite imported into Canada. There had been an acute anthracite shortage in the winter of 1918–19, due largely to the great increase in demand, generated by the war, both here and in the United States, and a second crisis in the winter of 1922–23, precipitated by a five months' strike in the United States anthracite fields in 1922. Furthermore, it was believed that United States anthracite reserves were inadequate to prevent a long-term contraction of imports. The United States Bureau of Mines had unofficially warned the Canadian Department of Mines that within a very short time Canada would have to work out her own solution for replacing the anthracite previously imported from the United States, and three bills were placed before the United States Congress to place an embargo on the export of anthracite to Canada. The bills were not passed, but it is not surprising that Order in Council P.C. 2381 of November 25, 1922, which set up the Dominion Fuel Board, referred to "the certain ultimate necessity of substituting other fuels for anthracite coal for domestic heating purposes in Central Canada". The task of advising on the best means to effect that substitution was one of the principal tasks with which the Dominion Fuel Board was charged.

Notwithstanding the concern as to United States anthracite reserves that prevailed in the 1920's, the enquiries of this Commission have demonstrated that there is now no reasonable ground for anxiety. Production in the Pennsylvania anthracite fields is presently in the neighbourhood of 60 million tons annually, at which level the field is estimated to have a life of over 100 years. Furthermore, Central Canada is regarded by anthracite producers as a natural and favourable market for their product, and, barring an unexpected demand in the eastern States for anthracite, or prolonged interruption of production, Central Canada should be able, with confidence, to look for anthracite supplies

of 4,000,000 tons, or even a greater amount, annually, from this source. Assurances as to anthracite reserves have been furnished to the Commission by the producers, by the Commonwealth of Pennsylvania, and also by the United States Department of Mines, and it is on information furnished from these sources that the prediction of reasonably adequate reserves is made.

Many informed and disinterested observers in the United States are of the opinion that the Pennsylvania anthracite industry is much more likely to be limited by a restricted market than it is by inadequate reserves. Both before and during the war, anthracite has been under heavy pressure from bituminous coal, oil and natural gas. Increasing difficulties in the field due to the fact that the more readily available reserves are steadily being exhausted and the remaining ones are more costly to mine and tend to produce a less favourable balance of sizes, have contributed to the deterioration of anthracite's competitive position. While these considerations suggest that anthracite may continue to be more expensive than it was in pre-war years, they confirm the conclusion that there is no cause for alarm as to the adequacy of supply.

Most of the anthracite used in Canada is burned in equipment specially designed for it. Anthracite is a very low volatile fuel and therefore equipment designed for it has a smaller combustion space above the fire bed and a smaller flue diameter than it would have were it intended for more volatile fuel. This means that the success with which other fuels can be used satisfactorily in such equipment depends to a considerable extent on their volatile content. Coke, like anthracite, is a low volatile fuel and is in this respect a suitable substitute fuel. Bituminous and lower-rank coals increase in volatile content as the rank falls. While even the so-called low volatile bituminous coals are more volatile than anthracite, they are not sufficiently so to be unsatisfactory substitutes in this respect. However, the volume of gas given off during combustion by high volatile bituminous is so great that it is difficult to obtain complete combustion of it in the combustion chamber and soot, smoke and lower efficiency result. The volatility of a fuel is not the only consideration which determines its suitability as a substitute for anthracite in equipment designed for anthracite. In forced-draft equipment, for example, the clinkering properties of the fuel used are often the determining factor. But volatility is probably the most important single factor, particularly in natural-draft equipment. Over a period of a few years the type of combustion equipment installed must be considered as more or less fixed, and the nature of the rigidity which this circumstance introduces into the retail market must be borne in mind when considering the part played by alternatives to anthracite in the retail market in Central Canada.

The importance of coals other than anthracite in the retail trade appears to have grown substantially over the last three decades. From the Final Report of the Fuel Controller of World War I it would appear that bituminous and lower rank coals were then much less used by small consumers than is the case today. In the years 1928 to 1932, about 27 per cent of the coal and coke sold retail was coal of bituminous or lower rank. In 1937 the comparable percentage was 40 per cent and it has remained at about that level during World War II. The wartime experience may, however, be misleading, for both anthracite and coke were relatively scarcer than bituminous and other coals during the period.

Retail sales of coals other than anthracite in Central Canada in the twelve months beginning April, 1940, are given below. The period is believed to be typical of the pre-war years except that United Kingdom bituminous coal did not normally enter the retail trade.

—	Thousands of Net Tons	Percentage of Total Retail Sales of Coal and Coke
United States low volatile bituminous	670	9.2
United States high volatile bituminous	1,495	20.5
United Kingdom bituminous	33	0.5
Nova Scotia bituminous	438	6·0
Western bituminous and sub-bituminous	176	2.4

In 1940 about 70 per cent of retail sales of United States high volatile in Central Canada were stoker and slack sizes, indicating that this coal was used predominantly in automatic combustion equipment. In contrast, nearly 85 per cent of retail sales of low volatile coal were of domestic sizes, used chiefly in hand-fired natural-draft equipment. The reason for this difference as suggested earlier, is that, whereas low volatile coal tends to be a more or less satisfactory substitute for anthracite in hand-fired, natural-draft equipment, high volatile coals are a less satisfactory substitute unless automatic or specially designed equipment is used.

Because Nova Scotia coal is a high volatile coal, it is not a very satisfactory substitute for anthracite in the type of small hand-fired equipment common in Central Canada. By 1940, Nova Scotia coal had won most of the retail market for high volatile coal in the Quebec and Montreal areas, and rather less than half of that market in the Ottawa area. No Nova Scotia coal has been sold retail in the Toronto area, which normally absorbs nearly two-thirds of the United States high volatile coal sold retail in Central Canada.

Recent developments in the design of small combustion equipment may increase the retail outlet for Nova Scotia coal in Central Canada. Efforts currently being made to develop stoves and furnaces which will burn satisfactorily a wide variety of bituminous coals are discussed in the chapter Combustion. The fact that in 1940 the retail trade of the Montreal area absorbed more than 1,400,000 tons of coal of all kinds, of which only about 300,000 tons was from Nova Scotia, indicates the size of the market that suitable combustion equipment might open to Nova Scotia coal.

During the 1920's there were numerous experiments made in the shipment of Western sub-bituminous coal to the Ontario market. The high transportation cost is, of course, the main factor prejudicing such movement. With the introduction of what is commonly known as the "flat rate" subvention of \$2.50 per ton in 1933, movement of this coal to Ontario stabilized itself at around 60,000 tons annually. This coal has a B.t.u. value of from 10,000 to 11,000, and some of it (notably that from Drumheller) stores favourably only under cover. It is particularly satisfactory as a substitute for wood fuel for domestic use. During World War II, with coal in short supply, the movement of this coal into Ontario increased substantially, reaching about 270,000 tons in 1942 and then supply problems in the West resulted in the Coal Controller prohibiting further shipments to Central Canada. In 1943 the Emergency Coal Production Board sponsored a number of stripping operations in Alberta producing sub-bituminous coal, and for the coal year ending March 31, 1946, close to 250,000 tons of strip and deep seam sub-bituminous coal moved eastwards to meet emergency conditions in Ontario. Small amounts of this tonnage found their way into Quebec.

During the summer of 1946, with a coal shortage in prospect for the coming winter, further movement of Alberta sub-bituminous coal into Central Canada is being facilitated by the Coal Controller.

If any satisfactory arrangement could have been worked out in the pre-war years for spring and summer movement of this coal to Central Canada and adequate storage facilities had been available there, the flow into that market might have been considerably larger. As it was, however, delivery was normally postponed until the fall months, at which time the western sub-bituminous mines were usually taxed to meet the requirements of the market to which they ordinarily had access without assistance, and many deliveries contracted for were not made. As long as movements of western coal to Central Canada have the effect of accentuating the seasonal characteristics of the industry, they are not likely to become very great.

Some mention must be made of the prospects for the development of a movement of Alberta low volatile bituminous coal into Central Canada for domestic use. There are in Alberta various deposits of low volatile bituminous coal which, from the point of view of combustion, would be a suitable substitute for anthracite in the equipment common in the region. So far this coal has never been adequately prepared in larger sizes for the domestic market in Central Canada and there has been no significant movement of such sizes. There has, however, been a small movement of briquettes, principally from Canmore Mines. Plans for doubling the size of the briquetting plant at that mine are now under way and the movement of briquettes is likely to increase, provided that subvention assistance is not reduced. It is also probable that there will be steps taken by one or more low volatile operators to improve the preparation of domestic sizes, with the purpose in part of developing a market for such sizes in Central Canada. One of the principal difficulties involved in such an attempt is that the low volatile coal of Alberta is very friable and a heavy percentage of fines would result from the long rail shipment and the handling involved in movement to Central Canada.

Since early in the 1920's a good deal of attention has been paid to the possibilities of increasing the use of domestic coke as a substitute for anthracite in Central Canada and various kinds of Federal aid have been offered to stimulate its use. Details of the development of the coke and gas industry in Canada and of the effect which government aid had on that development are provided in the chapter Products and By-Products. Comment here will be restricted to observing that while domestic coke is a reasonably satisfactory substitute for anthracite, the latter fuel is normally preferred and coke can be sold to domestic users only when it is offered at a somewhat lower price. Although domestic coke consumption in Central Canada has been 1,000,000 tons or more annually since 1928, except for the years of World War II, it has not expanded to the degree that many had hoped. The increase in its use in 1945 was due largely to efforts of the Coal Controller to meet an over-all shortage of solid domestic fuels and is not likely to be representative of the next few years.

The Industrial Market

Industry requires energy for three principal purposes—for power, for process heating, and for space heating. In Central Canada coal has had to face strong competition from alternative energy sources in all these fields. Power needs are met mainly by water power; at least four-fifths of the power machinery installed in Central Canadian industry is fed by hydraulically generated electricity. Of the remainder, smaller power units generally use fuel oil and there are only a few plants, mainly in southwestern Ontario, that obtain their power requirements from coal. In the field of process heating coal has faced strong competition from both water power and petroleum. Vast quantities of secondary hydro

power are used for this purpose, mainly by the pulp and paper industry. Since the secondary power supplies are concentrated in the St. Lawrence Valley, the incidence of this competition falls particularly heavily on that section of the market to which Nova Scotia coal has easiest access. Throughout both the process heating and space heating fields there is a substantial and expanding use of petroleum products. In 1939 fuel oil deliveries in the two provinces for industrial use amounted to the coal equivalent of about 800,000 tons; by 1944 they had risen to the coal equivalent of nearly 1,500,000 tons. The wartime consumption may not be maintained, but industrial use of petroleum is expected to be considerably above the pre-war level in the years to come. After allowing for an expanding use of both water power and petroleum, however, coal will probably remain the main source of energy for industrial process and space heating.

It is estimated that the consumption of coal in Ontario and Quebec by all industrial users, other than the coke and gas industry, was about 5,000,000 tons per year in the more prosperous pre-war years. The annual consumption has fluctuated considerably with changes in the level of activity from about 3,600,000 tons in 1933 to 8,300,000 tons at the peak of wartime consumption. Details of the volume and source of industrial coal used in Central Canada for some recent years are given in the following table:

INDUSTRIAL USE OF COAL IN ONTARIO AND QUEBEC

(In net tons)

—	1937	1939	1940	1943
Anthracite	125,000	126,000	139,000	203,000
United States bituminous	3,468,000	3,250,000	3,635,000	7,089,000
Canadian bituminous and lower rank	1,713,000	1,650,000	1,793,000	962,000
United Kingdom bituminous	5,000	5,000	6,000	1,000
Total	5,311,000	5,031,000	5,573,000	8,255,000

The consumption by industry of anthracite in the pre-war years was normally less than 150,000 tons per year, and therefore not important. All but a small percentage of the anthracite so used was of small sizes, the availability of which was a sort of by-product through degredation of the supplying of domestic sizes to the retail market. Except for this small amount of anthracite, the coal used by industry in Central Canada has been bituminous coal.

Some ideas of the relative importance of various industries as users of bituminous coal may be obtained from the Census of Industry Reports prepared by the Dominion Bureau of Statistics. In the calendar year 1940, the bituminous coal consumption in Ontario and Quebec of the larger coal-consuming groups was as follows:

	Tons
Wood and paper products	1,600,000
Non-ferrous metal products	780,000
Iron and steel products	640,000
Non-metallic mineral products	610,000
Vegetable products	530,000
Textiles and textile products	480,000
	4,640,000

In the immediate pre-war years about 70 per cent of the bituminous coal required was supplied by United States mines. During the war years the dependence of industry on United States sources increased substantially until by

1945 about 95 per cent of the bituminous coal used was United States coal. The reliance of Central Canadian industrialists on United States coal has been, both in peace and in war, one of the outstanding features of this market. Throughout the 1930's it was the policy of the Canadian Government to increase the use of both eastern and western coal by industry in this area by means of subvention payments designed to make Canadian coal competitive with United States imports in areas where, without aid, they would not be. Although much of the discussion following is concerned with the factors affecting the use of Canadian coal in Central Canada, it must be borne in mind that the principal source of supply has always been the United States.

In the pre-war years Nova Scotia mines provided about one-third of the coal required for industrial purposes in Central Canada. The industrial use of Nova Scotia coal amounted to from 1,500,000 to 2,000,000 tons annually and accounted for more than one-half of all the Nova Scotia coal moved into Central Canada. The first year for which figures are available to show the use of Nova Scotia coal and imported coal by smaller areas is that beginning April 1, 1940. These figures are given below. The smaller areas are those used by the Dominion Bureau of Statistics and shown on a map reproduced annually in "Coal Statistics for Canada".

USE OF BITUMINOUS COAL BY INDUSTRY IN CENTRAL CANADA FOR TWELVE MONTHS APRIL, 1940, TO MARCH, 1941, INCLUSIVE[1]

(In thousands of net tons)

—	Nova Scotia Coal		Imported Bituminous Coal	Total Bituminous Coal	Nova Scotia Coal as Per Cent of Total Bituminous Coal
	Tonnage Used	Per Cent of Total Nova Scotia Coal Used			
Quebec Area	160	9.8	355	515	31
Montreal Area	722	44.5	242	964	75
Ottawa Area	202	12.4	293	495	41
Northern Area	392	24.2	413	846[2]	46
Kingston Area	5	0.3	100	105	5
Toronto Area	101	6.2	1,302	1,403	7
Windsor Area	42	2.6	531	573	7
Western Area	Nil	Nil	195	222[3]	Nil
Total	1,624	100.0	3,431	5,123[1]	32

[1] Table covers 94 per cent of industrial tonnage of bituminous coal used in Ontario and Quebec.
[2] Includes 41,000 tons of Western Canadian coal.
[3] Includes 27,000 tons of Western Canadian coal.

A considerable part of this market for Nova Scotia coal was won only with the aid of Federal subventions. From one-half to two-thirds of all the Nova Scotia coal moved into Central Canada in the middle and late 1930's was aided by subvention payments.

The price factor (price net of subvention where applicable) was, of course, the major factor determining the extent to which Central Canadian industrialists used Nova Scotia coal, but there were a number of other factors. In the first place, approximately 10 per cent of the United States bituminous used by industry was low volatile coal. Generally speaking, low volatile coal commands a premium over high volatile coal and the use of it is largely explained by its particular suitability for the equipment in which it is used. For such equipment Nova Scotia coal would be unsuitable. Secondly, Nova Scotia coal has a lower ash fusion temperature than many, though not all, of United States coals and in some combustion equipments Nova Scotia coal will not perform satisfactorily

for that reason. Furthermore, Nova Scotia coal has a higher sulphur content than some United States coals and in furnaces where the material to be heated is in direct contact with the products of combustion, for example, in the baking of bricks and porcelain, the reheating of steel billets, etc., the presence of sulphur in the combustion gases can have very harmful effects. The Dominion Steel and Coal Corporation has estimated that the market affected in Quebec and Eastern Ontario by equipment unsuitable for the use of Nova Scotia coal because of ash fusion temperature and sulphur content is approximately 500,000 tons per year. Since a part of the tonnage included in that figure has already been displaced by secondary power, the market restriction in that area due to unsuitable equipment is unlikely to be more than 300,000 tons annually.

There are undoubtedly a number of plants in Central Canada which have never used Nova Scotia coal but which could use it satisfactorily if it were available at a competitive price and in adequate volume. There are, however, for the reasons listed above, a number of others which could not. There has been and still is available from the United States a much wider range of coals than from Nova Scotia and industrialists have chosen their combustion equipment accordingly. This circumstance must not be left out of account when considering the market that would exist for Nova Scotia coal in Central Canada if the price could be made competitive.

After 1940 the movement of Nova Scotia coal into the central industrial market fell off until in 1945 it almost ceased. It is just now beginning to move again. Notes on the present competitive position of Nova Scotia coal will be included at the end of this discussion of the Central Canadian market.

Very little western Canadian coal entered the industrial market in northwestern Ontario during the 1930's. That market consists principally of pulp and paper mills at Kenora, Fort Frances and Dryden and was supplied mainly by United States coal from docks at Fort William and Duluth. From 1937 on some sales were made by western bituminous mines in this area with subvention aid, and the market expanded until 1942 when, by order of the Coal Controller, shipments were discontinued. The accessability to stock piles of United States coal at lake-head ports is a considerable inducement to industrialists in the area to use United States coal rather than to stockpile Canadian coal themselves. For this reason the western bituminous operators claim that they will not be able to compete with United States coals under a subvention provision such as that of P.C. 4740 in effect since June 5, 1942, which does no more than equalize laid-down costs.

The Coke and Gas Market

Little will be said here about the coke and gas industry for that industry is dealt with at length in another section of this report. The industry is a large consumer of coal, about 90 per cent of which in pre-war years was United States bituminous. The only plant which has used a large tonnage of Canadian coal is that of the Montreal Coke and Manufacturing Company at Ville LaSalle.

Coke consumption in Central Canada for a few recent years is given below.

COKE CONSUMPTION IN CENTRAL CANADA
(In net tons)

—	1937	1940	1943	1945
Retail Sales	1,000,000	1,134,000	957,000	1,988,000
Industrial Use	1,268,000	1,698,000	2,539,000	2,480,000

The main use of industrial coke is by the Steel Company of Canada at Hamilton and Algoma Steel Corporation at Sault Ste. Marie for metallurgical purposes.

The Railway Market

In the pre-war years the coal consumption of the railways in Central Canada was about 4,200,000 tons annually. Railway requirements have, however, varied over the last 15 years from 3,315,000 tons in 1933 to 7,463,000 tons in the peak war year, 1943. The use of petroleum in the region is very limited and is restricted to a few diesel locomotives employed for switching purposes. Further details of railway coal consumption for various years are given below.

COAL CONSUMPTION OF THE RAILWAYS IN CENTRAL CANADA

(In net tons)

—	1930	1933	1937	1940	1943	1945
Canadian coal	746,000	879,000	1,157,000	1,593,000	258,000	122,000
Imported coal	4,295,000	2,436,000	3,005,000	2,713,000	7,205,000	7,296,000
Total	5,041,000	3,315,000	4,162,000	4,306,000	7,463,000	7,418,000

In all the years covered in the table above, railway consumption in Central Canada amounted to about 55 per cent of total railway consumption in all of Canada.

Most of the bituminous coal used by the railways in Central Canada has been United States coal. In this respect the region was unique; in fact, more than 98 per cent of the bituminous coal imported into Canada for locomotive use in 1939 was used in Ontario and Quebec. During the war years the demand for coal was too heavy to allow this situation to continue and substantial quantities of United States coals were used on the Prairies.

The consumption of United States bituminous coal by railways in Central Canada was nearly 3,000,000 tons per year in pre-war years. Of the two larger railways, the Canadian Pacific Railway Company bought United States coal through a number of Canadian importers in Montreal and Toronto, whereas the Canadian National Railways obtained the major part, and in some years practically all, of its United States requirements from mines which it owns and operates in Ohio, known as the Rail and River Coal Company. The Canadian National Railways expect that in the post-war years about 500,000 tons per annum will be available from the output of the Rail and River Coal Company for use in Canada.

The use of Canadian bituminous coal by the railways in Ontario and Quebec first exceeded 1,000,000 tons in 1934, and reached a maximum of nearly 1,600,000 tons in 1940, after which, due to war conditions, it fell off steeply until by 1944 it was only 100,000 tons. The use of Nova Scotia coal was fairly steady at about 1,100,000 tons annually from 1936 to 1940 inclusive, and declined very rapidly after 1941. Purchase of western Canadian coal for use in Ontario rose from 80,000 tons in 1938 to nearly 700,000 tons in 1941 and then dropped off to 55,000 tons in 1943.

The principal railway user of Nova Scotia coal in Quebec in pre-war years was the Canadian National Railways. This is illustrated by the following table:

COAL CONSUMPTION BY RAILWAYS IN QUEBEC

Averages for Years 1936–1940, Inclusive

(In net tons)

—	Nova Scotia Coal	Imported Coal	Total Coal	Nova Scotia Coal as Per Cent of Total Coal
Canadian National Railways	669,000	34,000	703,000	95
Canadian Pacific Railway Company	124,000	280,000	404,000	31
All other railways	8,000	17,000	25,000	32
Total	801,000	331,000	1,132,000	71

Of an average annual consumption of about 270,000 tons of Nova Scotia coal in Ontario by railways during the years 1936 to 1940 inclusive, at least 80 per cent was used by the Canadian National Railways. In 1939 this railway extended the use of Nova Scotia coal to points as far west as Toronto and Cochrane. A substantial part of the coal purchased by the Canadian National Railways in Nova Scotia moved under subvention. In the years from 1936 to 1939 the average annual tonnage of this company's purchases under subvention in Nova Scotia was 612,000 net tons, amounting to 47 per cent of total purchases in that province. In the fifteen years from 1930 to 1945, subventions were paid on 5,072,000 net tons of Nova Scotia coal purchased by the Canadian National Railways.

The coal requirements of the Canadian Pacific Railway Company in Central Canada are substantially smaller than those of the Canadian National Railways. In the pre-war years the Canadian Pacific Railway Company limited its use of Nova Scotia coal to divisions between Montreal and Quebec City in the Province of Quebec. On all other lines in Quebec and in Eastern Ontario, and on the main line from McAdam Junction, N.B., to Montreal, little, if any, Nova Scotia coal was used.

In the pre-war years the Nova Scotia coal available for railway use in Central Canada was normally run-of-mine coal. The burning of fines in locomotives is inefficient due to stack loss, and therefore run-of-mine coal, because it contains a higher percentage of fines, is a less suitable fuel than screened coal. The difference in the extent to which the two major railways use Nova Scotia coal appears to arise from the greater preference of the Canadian Pacific Railway Company for prepared sizes. In this connection it might be noted that Dominion Steel and Coal Corporation Limited erected a mobile screening plant at its Windmill dock for the purpose, among others, of furnishing prepared sizes for the Ontario Northland Railway, whose operating experience has dictated the use of sized coal. An increase in the supply of screened coal to the railroads by the Nova Scotia producers results in slack sizes, which must also be marketed; screened coal can, therefore, only be provided for the railways insofar as there is a market for the resulting slack.

A very considerable amount of Nova Scotia coal for locomotive purposes is marketed in Central Canada by the aid of subventions which are based on the difference between the laid-down cost of Nova Scotia coal and the United States coal that would otherwise be used. Therefore, the closer railway consumption can be to Montreal, to which point Nova Scotia coal is water-borne, the less will be the amount of aid per ton necessary to make the Nova Scotia coal competitive. Consequently, if Nova Scotia coal, as made available to railway purchasers at Montreal, had been acceptable to the Canadian Pacific Railway, and more of it had been used by that company and less by the Canadian National Railways, the same amount of Nova Scotia coal could have been marketed in Central Canada at a lower cost to the Federal Treasury.

The bituminous coal producers in western Canada are particularly dependent on the railways for an outlet, and with the introduction in the early 1930's of the subvention policy, specific provision was made to encourage the furtherance of western coal for use by the railways into Ontario. The aid commenced at points near the boundary of Manitoba and Ontario. The tonnage moved gradually increased until the disturbances caused by war resulted in United States coal meeting locomotive needs in most of Manitoba. The following table shows purchases by each of the major railways on which subventions were paid. Small amounts of the tonnages shown were consumed in Manitoba, but most of the coal was used in western Ontario.

ALBERTA AND BRITISH COLUMBIA CROW'S NEST COAL MOVED UNDER SUBVENTION FOR RAILWAY USE

(In net tons)

Year	Canadian National Railways	Canadian Pacific Railway Company
1933	8,272	16,732
1937	8,572	77,928
1939	68,133	176,095
1941	207,105	518,492
1944	2,979	9,725

The above figures reveal that, in contrast to the situation in eastern Canada, the Canadian Pacific Railway Company made greater use than did the Canadian National Railways of the subvention provisions to expand the market for western Canadian coal.

There is at present little prospect that western Canadian coal will be moved into Ontario for railway use in the future without subvention or comparable assistance.

The Bunker Market

Bunker deliveries from Central Canadian ports are restricted largely to lake and river vessels. For the pre-war years very little is known about this trade and the figures shown, ranging just over 500,000 tons per year, are no more than indications of the order of its magnitude. Most of the bunker coal supplied was United States bituminous.

NOTES ON NOVA SCOTIA AND UNITED STATES BITUMINOUS COAL IN THE CENTRAL CANADIAN MARKET

For more than twenty years the most interesting and decidedly the most controversial feature of the Central Canadian bituminous coal market has been the role played in it by Nova Scotia coal. There are two main reasons for this. The first is that for almost the whole of the period it has been the policy of the Federal Government to encourage by financial assistance the movement of coal from eastern and western Canadian mines into Central Canada. The second is that, due largely to the capacity of the Nova Scotia mines and to the fact that they are more favourably located for the Central Canadian market than are those of the other coal-producing provinces in Canada, the great bulk of the bituminous coal that has moved into Ontario and Quebec with the aid of Federal subvention payments has been Nova Scotia coal.

Tonnages of Nova Scotia and United States bituminous coal retained for consumption in Ontario and Quebec from 1929 to 1943 are set out in the following table:

NOVA SCOTIA AND UNITED STATES BITUMINOUS COAL RETAINED FOR CONSUMPTION IN QUEBEC AND ONTARIO

(In net tons)

With Nova Scotia coal shown as a percentage of total Nova Scotia and United States bituminous coal retained for consumption.

—	Quebec		Ontario		Quebec and Ontario	
	Nova Scotia Bituminous	United States Bituminous	Nova Scotia Bituminous	United States Bituminous	Nova Scotia Bituminous	United States Bituminous
1929	2,671,000	...	85,000	...	2,756,000	14,310,000
Per cent	...	...	...	...	16	...
1931	1,811,000	...	99,000	...	1,910,000	10,173,000
Per cent	...	...	...	...	16	...
1933	1,710,000	...	469,000	...	2,179,000	8,058,000
Per cent	...	...	...	...	21	...
1935	1,722,000	736,000	926,000	8,326,000	2,648,000	9,062,000
Per cent	70	...	10	...	23	...
1937	2,232,000	1,360,000	1,211,000	10,789,000	3,443,000	12,149,000
Per cent	62	...	10	...	22	...
1939	2,256,000	1,297,000	1,293,000	8,350,000	3,549,000	9,647,000
Per cent	63	...	13	...	27	...
1941	1,922,000	4,104,000	177,000	13,496,000	2,099,000	17,600,000
Per cent	32	...	1	...	11	...
1943	678,000	6,334,000	...	16,945,000	678,000	23,279,000
Per cent	10	...	...	...	3	...

It is readily apparent from the figures that United States bituminous mines have been a far more important source of supply for the Central Canadian market than have the Nova Scotia mines. Even in 1939, when movements from Nova Scotia reached their peak, both absolutely and relatively, nearly three tons of United States bituminous moved into Central Canada for each ton of Nova Scotia bituminous. During the years of World War II, the decline in Nova Scotia production and the rapid rise in Maritime coal requirements very nearly eliminated the tonnage of Nova Scotia coal that could be allotted to the Central market and the bituminous coal requirements of the Central provinces in the latter war years were met almost entirely from United States sources. Now that the war is over there will once again be a considerable tonnage of Nova Scotia coal available for the Central Canadian market. The question of what aid, if any, should be extended by the Federal Government to facilitate the movement of that tonnage is perhaps the basic question of Federal coal policy. The purpose of this note is to survey briefly the more important factors affecting the competitive strength of Nova Scotia bituminous coal in the Central market and then to attempt some indication of what may be expected to happen in that market in the near future if no direct aid is granted to Nova Scotia coal.

The United States mines from which bituminous coal normally moves into Canada are located in the Eastern Appalachian area. This area is rectangular in shape, running from the New York-Pennsylvania border south into Tennessee. It comprises the following coal-producing districts:

District No. 1 .... Central Pennsylvania
District No. 2 .... Western Pennsylvania
District No. 3 .... Northern West Virginia
District No. 4 .... Ohio
District No. 6 .... West Virginia Panhandle
District No. 7 .... Southern Low Volatile
District No. 8 .... Southern High Volatile

With the addition of District No. 5—Michigan, from which no coal is exported to Canada, these Districts constitute what is known as Price Area No. 1. During World War II, Canada imported a considerable amount of coal from District No. 9—Western Kentucky, District No. 10—Illinois, and to a lesser extent District No. 11—Indiana, all in Price Area No. 2. This coal moved to the head of the lakes for use principally on the western lines of the railways. Normally, however, there is very little bituminous coal shipped into Central Canada other than from Price Area No. 1.

Generally speaking, the highest quality coal produced in the United States is produced in Price Area No. 1. From it has come all of the coal used to fuel the highly industrialized middle Atlantic and New England States, as well as almost all of the United States bituminous moved into Ontario and Quebec. Price Area No. 1 produces more than two-thirds of the bituminous coal produced in the United States. In the years 1936 to 1940 its output averaged nearly 300,000,000 tons annually and by 1944 it had risen to almost 425,000,000 tons. In the pre-war years approximately four per cent of the coal mined was shipped into Central Canada; during the war years the figure rose to nearly six per cent. Although the Central Canadian market absorbs a relatively small part of the total production of the area, there are a number of operators in it to whom the Canadian market is of first-rate importance.

The bituminous producers in Price Area No. 1 enjoy a considerable advantage over those in Nova Scotia in respect of cost of coal at the mine. This advantage is due mainly to the higher productivity of labour in the United States mines, which in turn is due in part to the fact that the United States coal seams are easier to mine. The average output per man per day in the deep-seam bituminous mines in the three States which are the principal sources of imported coal, namely Pennsylvania, West Virginia and Kentucky, was 5.3 tons in 1944, having risen from just under 5 tons in 1939. In contrast, the output per man per day in the largest Nova Scotia operation, that of the Dominion Coal Company, was approximately 2.7 tons in 1939, fell to about 1.7 tons in 1944, and still lower in 1945. The above comparison understates the actual position in that the United States mines supplying Canada generally achieve a higher productivity than the average for their States. The increase in overall output per man per day of the United States mines has been achieved despite the fact that very much more attention has been paid in recent years to the cleaning and sizing of the coal raised. The effect of better preparation has been to improve the grade of the coal and to strengthen thereby its competitive position in the market.

There are a great many independent bituminous operators in the United States and the bituminous coal market there has, therefore, normally been a highly competitive one. During World War I the capacity of the industry was greatly expanded and, since post-war bituminous requirements were considerably below the wartime peak, the industry was troubled continuously by surplus capacity. This circumstance intensified the competition between producers, particularly during the early 1930's. Under the combined effects of general industrial depression and fierce competition from alternative energy sources, bituminous coal requirements shrank rapidly. For the five years 1931 to 1935 inclusive, production fell to an average of about 350,000,000 tons annually, compared with nearly 500,000,000 tons throughout the 1920's. Competition between coal producers became extremely bitter, price warfare raged continuously and bankruptcy was widespread. All but the strongest operators were in difficulty and even they were not secure.

Under such circumstances, it is not surprising that there grew rapidly within the industry an interest in some sort of regulation which might alleviate the evils of excessive competition. In 1925 the report of the United States Coal Commission had recommended a measure of regulation by the Interstate Commerce Commission by means of a licensing system and, in both 1928 and

1932, bills based on this proposal and sponsored by the United Mine Workers of America were introduced in Congress. Neither bill got beyond the Senate Committee. In 1932 the high volatile operators in the southern fields launched Appalachian Coals Incorporated, the primary function of which was to establish and control minimum prices. In 1933, under the National Industrial Recovery Act, the Federal Government required coal operators to abide by a "Code of Fair Competition for the Bituminous Coal Industry", calling for the maintenance of minimum prices and elimination of unfair competitive practices. This code remained in effect until a Supreme Court decision of May, 1935, invalidated the Recovery Act, although segments of the coal industry had been conspicuous in evading it before that date. In August, 1935, the abandoned code was replaced by the Bituminous Coal Conservation Act, which created a National Bituminous Coal Commission, to supervise the determination of minimum prices for coal according to a prescribed formula, and the enforcement of those prices. This Act, in turn, was declared unconstitutional by a Supreme Court decision of May, 1936. It was followed by the Bituminous Coal Act of 1937 (commonly known as the Guffey-Vinson Coal Act), which provided for the establishment of minimum prices for coal sold in the United States or forwarded to Canada. It called for minimum prices to be established for each District in each Price Area such that the return to the Price Area as a whole would equal the weighted average costs of the Area and such that existing fair competitive opportunities would be preserved. Administration of the Act was put in the hands of a National Bituminous Coal Commission, appointed by the President by and with the advice and consent of the Senate. Expenses were to be met by appropriations made from the Federal Treasury and all bituminous coal producers were required to pay the Treasury an excise tax of 1 cent per ton on all output except that sold to governmental bodies and for export.

Effective minimum prices under the Bituminous Coal Act of 1937 were not established until September 3, 1940. All the mines in each District were given a letter classification for grade and a number classification for size for each variety of coal they produced and schedules were set up fixing the minimum price per net ton f.o.b. mines, for each combination of letter and number. In order to preserve existing fair competitive opportunities, the coal was further classified according to the market area into which it moved, with a different District minimum schedule for each market area. Normally, coal shipped to Canada moved under the minimum price schedules for Buffalo. As costs changed in the years that followed, the minimum price schedules were revised. However, the demand for coal increased so rapidly after Pearl Harbor that there was need for the enforcement of a maximum rather than a minimum price for coal. Accordingly, in May, 1942, the Office of Price Administration established maximum prices f.o.b. mines for all mines producing coal in the United States. Since that time there have been amendments made to the maximum price schedules to reflect increased costs of production brought about by wage increases and changes in working conditions approved by the Government. Maximum price schedules are still in effect in the United States and the demand for coal has remained so great that coal is at present selling at or near the maximum prices f.o.b. mines allowed under these schedules.

In the meantime the Bituminous Coal Act of 1937 has expired and it has to date (September, 1946) not been re-enacted. It is not our intention to forecast whether or not this Act will be re-enacted. On the one hand, the legislation is favoured by the producers of the major part of United States bituminous coal and is supported solidly by the United Mine Workers. Supporters of the legislation point out that the problem of surplus capacity in the industry, which contributed so largely to the price cutting in the 1930's, has been exaggerated during World War II. On the other hand, the competition offered by petroleum and natural gas is growing steadily and the low cost producers are bound to feel that minimum price regulation will reduce unnecessarily their

ability to compete with these alternative energy sources. Their attitude will find support in the general disinclination which there appears to be in the United States to continue Government regulation of industry any longer than is absolutely necessary.

The decision that the United States Government makes on the question of whether or not to re-establish minimum price regulation of the bituminous industry will have important repercussions on the coal market in Central Canada. If there is no regulation it is to be expected that in no more than a year or two there will be fairly vigorous price cutting by individual United States bituminous producers. Once price warfare starts, it will probably grow increasingly fierce and the price of bituminous coal in Central Canada may drop sharply. If, on the other hand, minimum price regulation is re-introduced, prices will probably decline much less. It seems only reasonable to expect some reductions in United States bituminous prices in any event, but the relative competitive strength of Nova Scotia coal in the Central market will undoubtedly be substantially greater if there is minimum price regulation in the United States than if prices are left completely uncontrolled.

In the years before World War II, Nova Scotia coal was competitive with United States bituminous coal without subvention aid on dock at Montreal, and at all ports lower on the St. Lawrence River. Consequently, a considerable tonnage of Nova Scotia coal moved into Quebec without direct financial aid. The figures for both unassisted and assisted movements from Nova Scotia into Central Canada for years from 1929 to 1943 are set out below. All Nova Scotia movements into Central Canada benefited from tariff protection of 50 cents per ton before June, 1931, and 75 cents per ton after that time. The term "unassisted" as used here means, therefore, unassisted by subvention.

SHIPMENTS OF NOVA SCOTIA COAL INTO CENTRAL CANADA

(In net tons)

—	Unassisted by Subvention	Assisted by Subvention	Unassisted Nova Scotia Tonnage as Per cent of Total Nova Scotia and United States Bituminous Retained in Central Canada
			Per Cent
1929	2,451,000	305,000	14
1931	1,508,000	402,000	12
1933	795,000	1,384,000	8
1935	1,010,000	1,589,000	9
1937	1,406,000	1,909,000	9
1939	1,240,000	2,421,000	9
1941	107,000	2,015,000	....
1943	225,000	453,000	....

The percentages shown above are of unassisted Nova Scotia tonnage to total Nova Scotia and United States bituminous tonnage retained for consumption in Central Canada and provide a rough index of the competitive strength of the Nova Scotia coal in the market for the years covered.

The approximate competitive position of Nova Scotia and United States coals alongside dock, Montreal, in 1939 and as at September, 1946, may be illustrated by the following cost figures:

SUMMER—1939

—	Nova Scotia Slack		United States Slack	
	Dominion Coal Co.	Old Sydney	District No. 2	District No. 3
	$	$	$	$
F.o.b. mine, net ton	3.41	3.81	1.40	1.10
Rail freight and loading	0.35	0.35	1.65	1.85
Vessel freight and insurance	0.61	0.61	0.86	0.86
Duty	....	....	0.75	0.75
F.a.s. Montreal dock	4.37	4.77	4.66	4.56

SEPTEMBER—1946

—	Nova Scotia Slack		United States Slack	
	Dominion Coal Co.	Old Sydney	District No. 2	District No. 3
	$	$	$	$
F.o.b. mine, net ton	7.21	6.31	3.31	3.03
Rail freight and loading	0.45	0.45	1.85	2.08
Exchange	....	....	0.03	0.03
Vessel freight and insurance	1.40	1.40	1.01	1.01
Duty	....	....	0.75	0.75
F.a.s. dock Montreal	9.06	8.16	6.95	6.90

The figures for Nova Scotia slack are based on information provided by the Dominion Steel and Coal Corporation. The f.o.b. mine costs include allowances for depreciation and depletion; in 1939 these allowances totalled about eighteen cents per net ton. The figures for U.S. slack are averages of actual costs incurred by one large importer in the Montreal area. In 1939 prices f.o.b. U.S. mines and vessel freight rates were matters of negotiation, and costs f.a.s. dock Montreal varied considerably from shipment to shipment; for example, mine prices for $\frac{3}{4}$-inch slack varied from $1.00 to $1.25 in District No. 3. In September 1946, U.S. coal normally sold at the ceiling price, but the ceiling varied from mine to mine; for example, some mines in District No. 2 were selling $\frac{3}{4}$-inch slack at $3.51.

It will be observed that in 1939 Dominion coal was strongly competitive at Montreal. At that time Old Sydney coal was somewhat less competitive, although it was not much out of line with the more expensive District No. 2 coals. By September 1946 the situation had changed radically. All coals had become much more expensive at Montreal, but the increase in the cost of Nova Scotia coals was much greater than in that of United States coals. In September 1946, Dominion coal was more than $2.00 per net ton more expensive than either District No. 2 or No. 3 coals. Old Sydney coal was more strongly competitive, but it was about $1.25 more expensive than U.S. coals. In any event, the production of Old Sydney Collieries is only about one-fifth of that of the Dominion Coal Company, and it seems unquestionable that if Nova Scotia coal is to move into the St. Lawrence market in any volume a considerable portion of it must come from the Dominion Coal Company.

The effect of the deterioration in the position of Nova Scotia coal is that it is at present not competitive with United States bituminous coal anywhere on the St. Lawrence River except possibly below Riviere-du-Loup and on the Gaspé Peninsula. If the present relationship continues, there will be no Nova Scotia coal of any consequence moved into the Central Canadian market without subvention assistance. Moreover, a very considerable subvention per ton would be required to move the coal even as far west as Montreal.

It is not easy to forecast what changes will occur in the competitive position of Nova Scotia coal in the St. Lawrence market in the next few years. The cost of moving Nova Scotia coal from the mine to the dock at Montreal is about 90 cents per ton more at present than it was in 1939, due largely to the increase in shipping rates. It is thought likely that these rates will remain above the pre-war level, although it is possible that they may be reduced by 50 per cent of the increase. Even should this happen, it would only improve the position of Nova Scotia coal in Montreal by 45 cents. The major uncertainty for the future is the cost at mine of Nova Scotia coal. In 1939 the Dominion Coal Company had an output per man per day of about 2.7 tons, whereas in 1945 it had fallen almost to 1.5 tons. While there does not appear to be any obvious physical reason why production per man per day could not return to the pre-war level, it is not at all certain that it will. However, to illustrate the effect that an improvement in output per man per day would have on the cost of coal at mine, it is estimated that, were an output of 2.2 tons per man per day to be reached, the coal could be produced at a cost of about $5.70 per net ton. This would amount to a reduction of $1.50 per ton in the present cost.

Insofar as the position of United States bituminous coal is concerned, it has already been emphasized that very much will probably depend upon whether or not minimum price regulations are brought into effect. The greater the post-war decline in United States bituminous coal requirements the more important will this factor be. In any event, some reduction in price at mine is to be expected. In respect of freight, there have recently been hearings conducted by the Interstate Commerce Commission in connection with an application by the United States railways to raise their rates on coal and other commodities. In the case of coal moving to Great Lakes ports, the increase asked was 15 cents per ton, or 7 cents per ton over the 8-cent increase recently granted for the duration of the hearings. It is widely believed that the increases asked by the railways will be granted. These increases, should they be granted, may very well be offset, however, by reductions in the water rates on coal moving as far down the St. Lawrence River as Montreal.

Although changes in the future are very much matters of speculation, it does seem abundantly clear that the competitive position of Nova Scotia coal in the Central Canadian market has deteriorated seriously during the war years and that, unless there is considerable improvement in the output per man day of the Nova Scotia mines, very little Nova Scotia coal will move into the Central Canadian market without direct financial assistance.

THE PRAIRIE MARKET

The term "Prairie", as used here, covers all of the Provinces of Manitoba, Saskatchewan and Alberta.

Coal is the major source of energy on the Prairies; in both 1937 and 1943 it appears to have provided slightly more than one-half of the energy obtained from all sources. The order of importance of the other sources is petroleum, wood fuel, water power and natural gas. There is a very considerable regional variation in the incidence of alternative energy sources on the coal market. Water power is important only in Alberta and Manitoba, the heaviest use of

wood fuel is in Manitoba and northern Saskatchewan, while the use of natural gas is largely confined to Alberta. The probable trend in the next few years in the importance of these alternative energy sources is discussed in the chapter Sources of Energy. The main uncertainties are connected with the reserve situation in respect of petroleum and natural gas. Unless further substantial petroleum reserves are found on the Prairies, coal may recapture a part of the market now using liquid fuel. If, on the other hand, natural gas reserves are proven to be as substantial as some now consider them to be, there is a possibility that the piping of the natural gas to additional communities on the Prairies may reduce the use of coal for domestic heating.

Production

Within the Provinces of Alberta and, to a lesser extent, Saskatchewan, lie several of the major coal-producing areas of Canada. Production in Alberta was about 5,500,000 tons per year in the late 1930's and rose to 7,750,000 tons per year during World War II. Of the Alberta output, more than one-half is bituminous coal and the remainder is sub-bituminous. It is common practice in Western Canada to classify all Alberta production as either "steam" coal or "domestic" coal. In a very general way this classification is based on use, the first group including those coals which are used primarily for steam raising, the second, those coals which are used primarily for domestic heating. Because it is a use classification, it does not accord exactly with the recently adopted A.S.T.M. classification, though, broadly speaking, coals of high volatile "A", or higher rank, are spoken of as "steam" coals, and those of lower rank as "domestic" coals. For convenience, the steam-domestic terminology will be used in this discussion of markets, although the reader is warned that the terms are somewhat misleading, some "steam" coal being very suitable for domestic heating, and "domestic" coal being used to a considerable extent for steam raising. The "steam" coals are produced on the eastern slopes of the Rocky Mountains, principally in the areas of the Crowsnest Pass, Mountain Park, Cascade and Nordegg. "Domestic" coal is produced on the same slopes in the Coalspur and Saunders areas and at many points on the Prairies, principally in the areas of Drumheller, Edmonton and Lethbridge.

Coal production in Saskatchewan was about 1,000,000 tons per year in the late 1930's and rose to more than 1,500,000 tons per year during the war years. All of the Saskatchewan production is lignite coal. It comes from the southern part of the province, mainly from the vicinity of Estevan.

There has been production of a very few thousand tons of lignite coal annually in the Deloraine district of Manitoba. The output is, however, much too small to be of any significance.

Consumption Estimates

The following table summarizes coal consumption on the Prairies by type of consumer:

COAL CONSUMPTION ON THE PRAIRIES

(In net tons)

—	1937	1939	1940	1943
Retail	2,661,000	2,488,000	2,583,000	3,546,000
Industrial	996,000	966,000	1,076,000	1,545,000
Coke and Gas Plants	155,000	164,000	168,000	177,000
Railways	2,342,000	2,276,000	2,568,000	3,492,000
Total	6,154,000	5,894,000	6,395,000	8,760,000

The principal market for the output of Prairie mines is in the Prairie region. Except for the latter years of World War II, almost all of the coal consumed in the Prairies was produced there. Such coal as was imported in pre-war years came almost entirely from the United States, and was special purpose coal.

The Retail Market

According to the Housing Census of 1941, nearly one-half of Prairie dwellings were heated principally by wood fuel. The importance of wood fuel was by no means uniform throughout the Prairies. In general, Manitoba relied more upon it than did Saskatchewan, and Saskatchewan more than Alberta. From the limited evidence available, it would appear that the importance of wood fuel has declined considerably throughout the Prairie region since 1941. The next most important fuel for house heating on the Prairies was coal, it being used in 1941 in some 45 per cent of Prairie dwellings. Of coal used for this purpose it is estimated that about 25 per cent was used in Manitoba, mainly in the Winnipeg area; about 40 per cent in Saskatchewan with consumption widely distributed; and about 35 per cent in Alberta. The importance of natural gas was not very great in 1941, at which time only about 7 per cent of Prairie dwellings used it as a principal fuel. In the areas in which natural gas is available, however, it is extremely important. The four main urban centres in Alberta, Edmonton, Calgary, Lethbridge and Medicine Hat, rely heavily on gas, and expanding pipelines supply a number of smaller communities. Proven reserves of natural gas in Alberta continue to grow and the use of the fuel for domestic heating is expected to increase slowly. Up to the present time there has been no appreciable use of natural gas in Saskatchewan. There is in prospect a pipeline from the Unity field to Wilkie and North Battleford, but it appears to be questionable whether sufficient reserves have been proven in Saskatchewan to justify a pipeline to Saskatoon. Development in Saskatchewan is, however, still in the primary stage and the piping of natural gas to Saskatoon may come fairly soon. Natural gas reserves in eastern Alberta are adequate to supply several Saskatchewan cities, but as yet the Alberta Government has shown no disposition to commit itself to allowing the export of gas over a long period of years.

The use of petroleum for domestic heating on the Prairies has not so far been very great, but there is evidence that its use is expanding at the expense of coal and wood. The future use of petroleum fuels for domestic heating on the Prairies depends very largely on the success that is achieved by current efforts to discover additional petroleum reserves in Alberta.

Retail sales of coal on the Prairies have in recent years been upwards of 2,500,000 tons per year. Further details of retail sales of coal and coke are given in the following table:

RETAIL SALES OF COAL AND COKE ON THE PRAIRIES

(In net tons)

—	1937	1939	1940	1943
Anthracite	4,000	3,000	5,000	2,000
Canadian coal	2,612,000	2,445,000	2,546,000	3,405,000
United States bituminous	45,000	40,000	32,000	139,000
Coke from coal	60,000	65,000	59,000	66,000
Total	2,721,000	2,553,000	2,642,000	3,612,000

The figures make it clear that there is only a very limited use of imported coal for domestic heating purposes. This has not always been true; in fact, at one time United States producers enjoyed a very substantial retail market

in Manitoba. Before 1918 some 400,000 to 500,000 tons per year of anthracite were used from Lake Superior westward, much of it in Manitoba. As a result of the serious shortage of anthracite at the end of World War I, shipments to this market were seriously restricted. Alberta coal producers, aided by the Alberta Government, took advantage of this situation to develop a substantial market for the output of mines which are now classed as sub-bituminous mines. Anthracite never regained its importance in the Manitoba market; by 1927 imports of that fuel had fallen to 33,000 tons, and they have continued to decline since that time. Up until the end of the 1920's, United States bituminous producers enjoyed a retail market of from 150,000 to 200,000 tons per year in Manitoba. Since that time the sales have declined steadily, largely due to the aggressiveness exhibited by the Saskatchewan lignite producers. By the end of the 1930's, the only market for United States coal left on the Prairies was the small one indicated by the above table, almost all of which is in Winnipeg. Most of the United States bituminous that does come in is used in domestic stokers especially designed for it, and that use promises to be steadily reduced by the introduction of stokers designed to use Canadian coals.

It is extremely difficult to break down retail sales on the Prairies by the field of origin of the coal. As a rough approximation, however, it appears that at the end of the 1930's about one-quarter of the coal sold retail was the output of "steam" mines in Alberta, the second quarter was Saskatchewan lignite, and the remainder was "domestic" coal from various Alberta districts.

Very little is known about the retail market of the "steam" mines. A portion of their retail tonnage is probably used for industrial and commercial purposes. A further portion is undoubtedly used in domestic stokers. Some of it is used in hand-fired, natural-draft domestic equipment; at least two of the "steam" mines produce a low volatile bituminous coal, which is a very satisfactory smokeless fuel for such equipment. Since 1937 there has been an increase in production of briquettes from the fines of these two low volatile bituminous operations. A large part of the output of briquettes is taken by the railways; nevertheless in 1940 some 70,000 tons entered the retail trade.

The market for Saskatchewan lignite production is more or less restricted to the rectangle lying between a line from Moose Jaw east to Winnipeg and the United States border. Prior to 1930 the main product of the Estevan field was deep-seam lump for the retail market. Since that time the development of stripping in that field, and the installation by coal consumers of suitable combustion equipment have increased the importance of the industrial market for lignite until, during the war years, the industrial market probably eclipsed in importance the retail market. In 1943, for example, only about 25 per cent of the output of the Estevan field was lump, the remainder being industrial sizes. There is a growing retail market for stoker sizes of lignite, particularly in Winnipeg, either alone or mixed with United States bituminous stoker coal. By 1937 there was an estimated retail sale of some 320,000 tons of Saskatchewan lignite in Manitoba. The retail market for this coal in Saskatchewan was probably somewhat smaller. There is one briquetting plant in the Estevan area with a capacity of about 60,000 tons per year. In this plant is briquetted not raw coal but the char from a low-temperature carbonization process. In recent years this plant has been operating at near capacity, and has found ready market for its output in Saskatchewan and Manitoba. Practically all of the briquettes sold are used for domestic purposes.

The production of "domestic" coal in Alberta comes from a number of fields. Some of these fields supply no more than a local market as, for example, does the Edmonton field; others ship widely to almost all points on the Prairies and to some extent to Ontario, notably the Drumheller and, to a lesser extent, the Lethbridge fields. Speaking generally, Alberta "domestic" coal producers

supply the entire retail market for coal in Alberta and northern Saskatchewan, and meet strong competition from Saskatchewan lignite along the line from Moose Jaw to Winnipeg. In the Winnipeg market they have felt increasingly keen competition from Saskatchewan lignite, particularly insofar as the higher rank "domestic" coals are concerned.

The Industrial Market

As at the outbreak of World War II the industrial market for coal on the Prairies was approximately 1,000,000 tons per year. Except for a few thousand tons of United States anthracite and United States bituminous, this market was supplied by western Canadian coal producers.

Western Canadian coal producers gained access to a substantial portion of the Manitoba industrial market only with the aid of Federal subvention payments. From 1930 on such payments were made on coal moving into that market from British Columbia Crowsnest, Alberta and Saskatchewan mines. During the 1930's the tonnage thus aided ran at about 100,000 tons annually from Alberta and from 50,000 to 100,000 tons annually from the British Columbia Crowsnest and it rose more or less regularly to 164,000 tons in 1937 from Saskatchewan. As at the outbreak of World War II over 300,000 tons per year of western Canadian coal were moving into the Manitoba industrial market with subvention assistance. These figures include movements to the coke and gas plant of the Winnipeg Electric Company Limited.

The costs of several western Canadian and United States coals on car at Winnipeg are presented in the table on the facing page. The figures for Canadian coals are after the price increases following the wage increases of October, 1946. This information indicates that Canadian coals are at present just competitive in the Winnipeg market. It is believed, therefore, that western Canadian coal will in the future be competitive without subvention aid throughout more of the Prairie market than it was in the pre-war years.

Because the Prairie provinces are not highly industrialized, the total industrial energy market is not large. The main competition that coal producers have met in the market has come from water power and petroleum. The use of petroleum for industrial purposes has not been very great but its competitive pressure was increasing fairly rapidly in the immediate pre-war years, particularly in the areas around the major western refineries. There has been some use of natural gas as an industrial fuel in Alberta and, as proven reserves of this fuel grow, its use may expand somewhat.

In order to indicate the relative importance of the larger industrial coal users on the Prairies, the following figures of coal consumption in 1941 are presented. They cover about 1,000,000 tons of an estimated industrial consumption of 1,300,000 tons for that year.

	Tons
Central electric stations	356,000
Dominion Briquettes and Chemicals Ltd	120,000
Colliery briquetting (Alberta)	118,000
Other colliery consumption	170,000
Meat packing	68,000
Non-ferrous metal smelting	54,000
District heating in Winnipeg	52,000
Cement manufacturing	40,000
Sugar manufacturing	38,000

The figures given above indicate the importance of the central electric station industry as a consumer of coal. Even so, well under one-half of the electricity generated in Alberta, and practically none of that generated in

COST OF COAL ON CARS AT WINNIPEG

District of Origin	United States Coals As at September, 1946				Canadian Coals As at November, 1946			
	Coal	Size	Cost on Car at Winnipeg	Approx. B.t.u. as received	Coal	Size	Cost on Car at Winnipeg	Approx. B.t.u. as received
			$				$	
1	Central Pennsylvania	Slack	10.56	13,600	Mountain Park	Slack	9.60	12,900
		Nut	11.21	13,800		Nut	10.05	....
		Lump and Egg	11.21	13,800		Lump	11.30	13,100
3	Fairmont	Slack	10.07	13,300	Crow's Nest	Slack	9.67	13,800
		Nut	10.57	13,600		Nut	10.17	....
		Lump and Egg	10.57	13,700		Lump	11.17	14,200
8	West Virginia High Volatile	Slack	10.75	13,900	West. Can. Bellevue	Slack	9.42	12,400
		Nut	11.05	14,000		Nut	9.82	....
		Lump and Egg	11.15	14,200		Lump	11.07	13,500
10	Southern Illinois	Slack	9.89	11,900	Drumheller	Nut	8.05	9,200
		Nut	10.54	12,070		Egg	10.35	....
		Lump and Egg	10.84	12,240		Lump	10.80	10,000
					Saskatchewan	Slack	2.80	7,300
						Stoker	3.90	7,300

Manitoba, is generated thermally. Even in Saskatchewan, where almost all the generation is thermal, about 20 per cent of the energy required is obtained from petroleum. Nevertheless, the relative importance of this market justifies special attention being paid to it.

It appears that Saskatchewan must continue to rely on the thermal generation of electricity. There are in Saskatchewan two hydraulic stations, a large one on the Churchill River near the Manitoba border, and a much smaller one on the Charlot River, north of Lake Athabaska; both of these stations are, however, much too far north to supply any of the electricity requirements of the populated areas. The only water power sites of any importance lying within transmission distance of populated areas are on the Saskatchewan River, north of Melfort. For a number of years consideration has been given to hydraulic developments there, but the sites are not entirely satisfactory and so far nothing has been done. The general pattern of electricity generation in the province is that the larger plants burn coal while the smaller ones burn oil, the principal coal-burning stations being at Saskatoon, Moose Jaw and Estevan. In 1939 the central electric station industry in the province consumed about 140,000 tons of coal, in 1941 over 175,000 tons, obtained from Saskatchewan and Alberta mines. Rural electrification may increase somewhat the industry's coal requirements but the increase is not likely to be substantial.

Alberta is served by both coal and hydraulic generating stations. Somewhat more than one-half of the power used in the province is generated in hydraulic stations of the Calgary Power Company on the Bow River, and is transmitted to Calgary and widely throughout the province over that company's lines. The largest coal-burning station is the municipal plant at Edmonton. In the late 1930's this plant used about 65,000 tons of coal per year. Consumption rose to over 150,000 tons annually in 1944 and 1945, during which period the plant supplied some 70,000,000 kilowatt hours net to the Calgary Power Company pending the completion of the Lake Minnewanka plant of that company. The Edmonton plant is an important outlet for the mines of the Edmonton coal field, whose total production in pre-war years was about 475,000 tons per year. While the coal requirements of the Edmonton plant during the war years are considered to have been abnormally high, the fact that the plant is to be increased substantially by 1948 gives promise of an annual coal consumption considerably in excess of the pre-war tonnage.

There are in Alberta three other coal-burning plants large enough to be important in their local coal markets. They are located at Drumheller, Lethbridge and Sentinel. They consumed 30,000, 15,000 and 8,000 tons respectively in 1941.

The development in mining fields of large coal-burning generating stations designed to use slack coal is often offered as an attractive solution to the marketing problems of Alberta coal producers. Alberta coals are relatively friable and the limited outlets existing for fines unquestionably constitute one of the major problems of most of the fields. The "domestic" mines, whose chief saleable product is lump coal, and whose fines have not been found easy to briquette cheaply and satisfactorily, would benefit enormously from such a development. The prospects for such a development are not, however, bright. The great water power potential of the Bow River and the general suitability of the various sites on it for power installations give hydro-electricity a strong initial advantage over coal. Much of the power market in Alberta lies within such easy transmission distance of those sites that coal cannot compete for it effectively. Even where thermal generation is competitive with water power, coal will probably come under increasing pressure from natural gas. The possibility that coal may, in the near future, capture a much larger share of the electricity market than it presently holds is therefore considered to be remote.

The coal requirements of three briquetting operations on the Prairies have been included in the figures of industrial consumption. The operations are those of the Dominion Briquettes and Chemicals at Taylorton in the Estevan field, Canmore Mines at Canmore and Brazeau Collieries at Nordegg. The Saskatchewan operation has a capacity consumption of 120,000 tons of coal per year, producing about 60,000 tons of briquettes. By a combination of carbonization and briquetting the process achieves an up-ranking of the local lignite coal to produce a high-grade domestic fuel. Unfortunately, the process requires lump coal and therefore contributes nothing to the problem of the disposal of fines. The Alberta operations at Canmore and Nordegg have been designed to use the fines of the mines to which they are connected. Their coal consumption has grown from about 19,000 tons in 1936 to 240,000 tons in 1944. Most of the Nordegg production has gone to the Canadian National Railways to be used as locomotive fuel, while most of the Canmore production has gone into the retail trade.

The Coke and Gas Market

Prairie coke and gas production comes almost entirely from two operations, that of the Winnipeg Electric Company in Winnipeg, and of the International Coal and Coke Company Limited in Coleman, Alberta. The former consumed about 56,000 tons in 1940; the latter about 109,000 tons. After a good deal of experimentation, and some difficulty in obtaining the quality required, the Winnipeg Electric Company was, at the outbreak of war, using mainly Canadian coal; the International Coal and Coke operation was using coal from its own mines exclusively. Most of the coke produced in Winnipeg is used for domestic heating and the operation is the main source of domestic coke for the Prairies. The major part of the output of the International Coal and Coke operation goes to the Consolidated Mining and Smelting Company for industrial purposes.

The Railway Market

Consumption by the railways accounts for some 35 per cent to 40 per cent of all the coal used on the Prairies. About one-half of this consumption is by the Canadian Pacific Railway Company and the other half by the Canadian National Railways, the requirements of all other railways being relatively small. Further details of railway consumption in selected years are given in the following table:

RAILWAY COAL CONSUMPTION ON THE PRAIRIES

(In thousands of net tons)

—	1930	1933	1937	1940	1943
Canadian	2,504	2,093	2,299	2,552	2,607
Imported	147	75	42	13	886
Total	2,651	2,168	2,341	2,565	3,493

The railway market for Canadian coal on the Prairies has increased more or less steadily since the beginning of the century. In the early days of railroading United States coal was used almost exclusively on western lines, but as mines were opened up in Alberta the use of Canadian coal gradually expanded. By 1930 there was relatively little United States coal used by railways in the Prairie provinces and throughout the 1930's imports continued to decline until by the outbreak of war there was practically nothing else but Canadian coal used in the area. By this time, in fact, the Canadian National Railways were using

western coal west of Port Arthur and Armstrong, and the Canadian Pacific Railway Company was using Canadian coal west of White River. A relatively small amount of Canadian coal was moved into eastern Manitoba with the aid of Federal subventions, but it is almost true to say that by the outbreak of war Canadian coal for railway use was competitive with United States coal as far east as the Manitoba-Ontario boundary.

As a result of the great increase in the requirements of almost all Prairie coal users during World War II and the necessity of diverting a substantial volume of Prairie coal production to the west coast of the United States to meet an emergency situation there, the railways found it necessary once again to import a considerable quantity of United States bituminous coal for use on the Prairies. Both major railway companies have stated their intention of returning to the use of Canadian coal when it again becomes available, providing that its competitive position has not seriously deteriorated.

The great bulk of the coal consumed by the railways on the Prairies is high volatile "A" bituminous, or higher rank, and is supplied to each of the major railways by operations on their own lines. The principal suppliers are as follows:

To the Canadian Pacific Railway Company

The Crow's Nest Pass Coal Company Limited....Fernie, B.C.
West Canadian Collieries Limited..............Blairmore, Alta.
International Coal & Coke Company Limited....Coleman, Alta.
The Canmore Mines Limited...................Canmore, Alta.
McGillivray Creek Coal & Coke Co. Limited.....Coleman, Alta.
Hillcrest-Mohawk Collieries Limited...........Bellevue,Alta

To the Canadian National Railways

Brazeau Collieries Limited.....................Nordegg, Alta
Cadomin Coal Company Limited...............Cadomin, Alta.
Mountain Park Coals Limited.................Mountain Park, Alta.
Luscar Coals Limited.........................Luscar, Alta.

For each of these groups, sales to the railway account for a very substantial proportion of their total sales. During the 1930's purchases by the Canadian Pacific Railway Company accounted for upwards of 70 per cent of the total sales of coal and briquettes by the above-mentioned Canadian Pacific Railway Company suppliers. During the same period, sales to the Canadian National Railways accounted for upwards of 85 per cent of total sales by the above-mentioned Canadian National Railways suppliers. It is therefore clear that the fortunes of these mines are very closely tied to railway coal requirements.

Considerable amounts of lower rank bituminous coals were also used by the railways as locomotive fuel. The principal suppliers of this coal were Coal Valley Mining Company Limited and Sterling Collieries Company Limited, both in the Coalspur area.

It is generally recognized that the most desirable coal for locomotive use is that which has been washed and which does not contain an excessive percentage of fines. The limitation on the percentage of fines is particularly important with low volatile coals. The railways in western Canada normally accept run-of-mine coal, although they do urge that the amount of fines be kept within reasonable limits. Because of the high percentage of fines in his run-of-mine, one low volatile operator briquettes a proportion of his production for railway use. Over the past years there has been steady improvement in the quality of the coal delivered by western operators to the railways. The notable improvement over the last two decades in the operating efficiency of both major railways, as reflected in the pounds of coal used per gross ton mile, has been due in no small part to the efforts of the operators in this connection.

There is a relatively small amount of fuel oil burned in Alberta in locomotives by both major railways in the immediate vicinity of the Alberta-British Columbia border. This area is merely the fringe of the much larger area in British Columbia in which oil is used extensively as a locomotive fuel. The reasons for the extensive use of fuel oil by the railways in British Columbia are discussed in the section on British Columbia markets.

In addition to their use of bituminous coal in locomotives, the railways were using, at the outbreak of war, about 350,000 tons per year of sub-bituminous and lignite coal for stationary installations and station heating. The Canadian Pacific Railway Company has zoned its western lines territory and used Saskatchewan lignite from Kenora west to Regina, and Alberta sub-bituminous particularly from the Drumheller, Lethbridge and Medicine Hat fields, from Moose Jaw to Calgary. Plants on the northern lines were supplied from the Edmonton field. The policy of the Canadian National Railways in this respect seems to have been somewhat similar. The expansion of this market for sub-bituminous and lignite coal has been facilitated by the introduction of modern combustion equipment.

The Export Market

In times of normal supply, there has been an export to the United States from Prairie mines of about 40,000 tons per year. Some two-thirds of this tonnage was bituminous coal of the "steam" variety, most of it from the Alberta Crowsnest Pass; the other one-third has been "domestic" coal, mostly from the Lethbridge area.

There is a widespread belief that there exists a large potential market for Alberta coal in the adjoining States of Montana and North Dakota. A survey of the coal supply of these areas reveals that this belief involves a serious misunderstanding of the market situation in that area. The coal requirements of these States are not large, for the area is not highly industrialized; moreover, most urban areas in Montana are well served by natural gas, and central Montana is supplied by hydro-electricity generated on the Missouri River. The coal production in Montana in recent years has far exceeded 5,000,000 tons, varying in rank from lignite to high volatile bituminous "C". The output of the higher rank coals, which are at least the equivalent of Lethbridge coals, is from mines having a man-day production of some 7 tons compared with about 3.5 tons for the Lethbridge area. In addition, strip mining is relatively extensive. Montana producers ship coal to various points from Minnesota west to Washington. At many points in Montana, the local producers are subject to strong competition from Wyoming coals. Wyoming production in 1942 was about 8,000,000 tons, most of it being of bituminous rank suitable for locomotive use. Finally, there is in North Dakota a production of lignite coal which, in 1942, was 2,500,000 tons, which precludes any significant export to that State from the lower-rank Alberta and Saskatchewan fields. Such a survey makes it abundantly clear that any hope of a large market for Prairie-mined coal in the adjacent United States is without reasonable foundation.

THE BRITISH COLUMBIA MARKET

The importance of coal as a source of energy is less in British Columbia than in any of the other areas into which Canada has been divided for purposes of the discussion of coal markets. According to estimates made for 1937 and 1943, coal was approximately equalled in importance as a source of energy by

each of water power and petroleum. The importance of water power in this province is as great relatively as it is in Ontario and Quebec, while the importance of petroleum products is nearly twice as great in British Columbia as in any other area in Canada. Furthermore, there is relatively more wood fuel used in this area than in any other in Canada; in fact, it appears that wood fuel provided somewhere from 15 per cent to 20 per cent of all the energy used in British Columbia.

This information indicates quite clearly that coal in British Columbia is under very strong pressure from almost all the alternative sources of energy and explains why the market for coal in that province is so limited. During the pre-war years the consumption of coal in British Columbia was just over 1,500,000 tons annually. During the war years it reached 2,000,000 tons annually but it is now declining and it is anticipated that consumption in the area will be well under 2,000,000 tons per year in the post-war years. There may be some slight lessening in the competitive strength of wood fuel in the area, but there is no reason to expect any decline in the use of water power or petroleum, and the combined pressure of all alternative sources of energy on coal is not likely to be reduced.

Production

Before the turn of the century production in British Columbia had attained a level in excess of 1,000,000 tons annually, and it reached a peak of 3,300,000 tons in 1910. In the past fifteen years, though always in excess of 1,000,000 tons, it was only during the years of World War II that it reached 2,000,000 tons. All the coal produced in the area is of bituminous rank. The principal producing areas are Vancouver Island, the Crowsnest Pass district in the southeastern part of the province, the area south of the main line of the Canadian Pacific Railway in the vicinity of Merritt and Princeton, and the Telkwa district, 200-odd miles east of Prince Rupert. The latter two of these areas are usually referred to as the Inland district.

Nearly 90 per cent of the province's coal output comes from the Island and Crowsnest Pass Districts. Since 1940 the Crowsnest Pass district has been a larger producer than the Island district and it promises to remain such. Future production on the Island is in considerable measure dependent on the mineable reserves remaining, concerning the size of which there is some doubt, whereas production from the Crowsnest Pass area, where reserves are adequate, will be wholly determined by the market available. The area around Merritt and Princeton at one time produced over 200,000 tons annually but its output has fallen in recent years, and even during World War II it produced less than 150,000 tons a year. The natural conditions in this district are unfavourable and it does not show promise of being an important factor in the future. The Telkwa area produces only about 8,000 tons annually. Although the selection of a year that is completely representative of any extended period is impossible, the comparative production of the various districts may be judged by figures for 1940, which are as follows:

	Tons
Crowsnest Pass	869,704
Island	821,051
Inland	177,091
Total	1,867,846

CONSUMPTION ESTIMATES

Estimates of the consumption of coal in British Columbia by type of user for a few recent years are given below.

COAL CONSUMPTION IN BRITISH COLUMBIA

(In net tons)

—	1937	1939	1940	1943
Retail	504,000	485,000	559,000	718,000
Industrial	390,000	375,000	380,000	491,000
Coke and gas plants	166,000	171,000	192,000	263,000
Railways	285,000	257,000	245,000	475,000
Bunker	200,000	241,000	176,000	81,000
Total	1,545,000	1,529,000	1,552,000	2,028,000

THE RETAIL MARKET

The outstanding feature of the market for domestic heating fuels in British Columbia is the widespread use of wood fuel. According to the 1941 Housing Census, 75 per cent of the occupied dwellings in the province were heated principally by wood fuel in one form or another, a percentage equalled only in New Brunswick. Since a further 6 per cent of the British Columbia households were heated principally by fuel oil, the domestic heating market for coal, coke and manufactured gas has been limited to about one-fifth of the dwellings in the province.

The following table shows the retail sales of coal and coke in British Columbia for various years.

RETAIL SALES OF COAL AND COKE IN BRITISH COLUMBIA

(In net tons)

—	1937	1939	1940	1943
Canadian bituminous and sub-bituminous	500,000	485,000	558,000	717,000
United States bituminous	4,000	Nil	1,000	1,000
Coke from coal	27,000	23,000	23,000	23,000
Total	531,000	508,000	582,000	741,000

The increase in the domestic use of coal during the war years can be explained in large part by the shortage that developed in the supply of sawdust and millwood. There are at present some developments in the wood industry in British Columbia that suggest that post-war supplies of sawdust and millwood may continue to be somewhat restricted. However, it is anticipated that this fuel will, to a substantial extent, recapture the position that it occupied prior to the war. It is also anticipated that the use of fuel oil for domestic heating will continue to expand. Therefore, the use of coal for domestic heating is expected to return to something not far above the pre-war level.

Of the retail sales in pre-war years about 200,000 tons were island production. The remainder of the coal came from inland mines and from Alberta. There has, for some years, been a substantial movement of coal from the Drumheller area into this province but a great part of the increased demand of war years was met by "domestic" mines in the Coalspur area of Alberta. The Macleod River mine is the largest shipper to British Columbia from that area, but various

other mines there have shipped and are shipping into the coast market. Drumheller will no doubt continue to be a source of supply for the interior around such centres as Kamloops and Revelstoke and some of this coal will probably move to the lower mainland. The Coalspur coals, because they enjoy a rail rate of $4.10 as against a Drumheller rate of $5.00 and possess better weathering qualities and higher calorific values than the Drumheller coals and are also free-burning in character, should continue to enjoy a good part of the market which has been developed for them in the war years. It appears that the post-war retail market in British Columbia should provide an outlet for upwards of 300,000 tons of Alberta coal.

The only coke and gas plant supplying any appreciable quantity of coke for retail sale is that at Vancouver. Coke as a domestic fuel enjoys little preference in the equable coastal climate and there is very little reason to expect any substantial increase in retail sales of coke in the province.

The Industrial Market

The consumption of coal by industry in British Columbia in pre-war years was about 380,000 tons annually. The relative importance of various industrial consumers may be judged from the following estimates, which are based mainly on 1940 consumption.

	Tons
Mining and smelting	240,000
Cement	30,000
Pulp and paper	25,000
Sugar	20,000
Central electric stations	10,000
Colliery use	30,000
	355,000

The overall energy requirements of industry in British Columbia are somewhat limited, for the province is not highly industrialized. Within the industrial energy market coal has met very strong competition from water power, from petroleum and from wood fuel. By far the greater part of the electricity generated is generated hydraulically; even for that portion which is thermally generated fuel oil and wood fuel are probably each as important as coal. There are very many undeveloped water power sites of large potential on the west coast, particularly on the Fraser River and its tributaries. The B.C. Power Corporation Limited is at present engaged in an extensive water power project on one of these tributaries, the Bridge River. So far there has been very little use made of secondary power in the province. Whether or not further hydraulic developments will allow the use of substantial quantities of secondary power is very much open to question, but it does seem clear that the primary power requirements of the province will continue to be supplied mainly by water power. Fuel oil deliveries for industrial heat and power, exclusive of railway use of ships' bunkering, amounted to the equivalent of 275,000 tons of coal during the immediate pre-war years. Fuel oil was used in large quantities by pulp and paper mills located at tidewater and receiving the fuel water-borne from California. Fuel oil use for industrial purposes increased by more than 50 per cent in war years and would have increased more if sufficient oil had been available. Most of the wood fuel used in the province enters the retail trade; nevertheless, very substantial use is made of it for steam raising, either for power generation or process heating, particularly by pulp and paper mills and sawmills. An effort was made during the years of World War II to ease the oil situation by the diversion of wood fuel in the form of hogged fuel to industrial consumers. The use by industry of wood fuel in the post-war period may be expected to decline somewhat, but the market opened is more likely to be filled by oil than by coal.

The Coke and Gas Market

There are two large coke and gas operations in British Columbia, that of the Crow's Nest Pass Coal Company at Michel, which used 88,000 tons of coal in 1939, and that of the B.C. Electric Power and Gas Company Limited at Vancouver, which used 71,000 tons of coal in 1939. Most of the coke produced by the Vancouver plant is sold in the retail market, whereas the output of the Crow's Nest Pass plant is supplied for the most part either to Consolidated Mining and Smelting Company, or exported to Idaho. The Consolidated Mining and Smelting operation brings in substantial quantities of coke from the International Coal and Coke plant at Coleman, Alberta.

The Railway Market

The consumption of coal by railways in British Columbia was about 275,000 tons annually in pre-war years. Statistical information is inadequate to indicate the source of the above tonnage except in the case of Island coal, which annually appears to have amounted to 60,000 tons. The balance is, of course, supplied largely by British Columbia and the Alberta mines in the Crowsnest Pass and by the Mountain Park area in Alberta. Until production in the Princeton area suffered a marked decline, the Canadian Pacific Railway secured a portion of its supplies from that area. During the years of World War II railway consumption rose to 475,000 tons due to large increases in traffic, particularly in freight.

The relatively limited use of coal by the railways in British Columbia is due to the extensive use made of fuel oil by the railways in that area. It is only on mountain divisions that Canadian railways use oil for steam raising in locomotives, but it so happens that almost all of these divisions lie within British Columbia. The Canadian National Railways use oil almost exclusively for all services west of Jasper. The Canadian Pacific Railway uses it exclusively on its main line between Field and Kamloops and also on secondary lines such as the Lake Windermere subdivision and on the Company's subsidiary, the Esquimalt and Nanaimo Railway, on Vancouver Island. The Canadian Pacific Railway uses oil and coal between Calgary and Field and between Kamloops and Vancouver on the main line and likewise both oil and coal are burned on the Kettle Valley line between Vancouver and Penticton. The Pacific Great Eastern Railway, owned and operated by the Province of British Columbia, and operating from Squamish to Quesnel with 387 miles of track, uses oil exclusively.

The conversion from coal to oil was effected about 1912, when an amendment to the Railways Act imposed increased responsibility on the railways for fires occurring adjacent to railway right-of-ways in forested areas. The use of oil was not, and never has been, made mandatory, but it appears to be conceded that the exclusive use of coal would necessitate a much more expensive patrolling of right-of-ways by the railways. The Canadian National Railways, in its submission, said that its records revealed that the chance of a coal-burning locomotive starting a fire was at least 25 times that of an oil-burning locomotive.

As might be expected there are other factors influencing the railways in their decision to use oil rather than coal. Their case in favour of oil may be summarized as follows: It is available at Prairie refineries and at tidewater on a favourable price basis. The use of coal would increase transportation costs in mountain areas where short tangents and long grades are encountered. Operating under these conditions with coal-burning locomotives would present special problems which would be reflected in slower and inferior service in both freight and passenger movements. Under mountain conditions it is imperative that locomotives develop maximum tractive effort, which is not possible with coal since the coal available contains a substantial percentage of fines. The use of oil increases the comfort and convenience of passenger service. Finally, the conversion to coal at this time would involve substantial expense. The Canadian

National Railways estimates that conversion to coal at the present time would involve a capital expenditure in excess of $1,000,000, and that annual operating expenses would thereafter be increased by $586,000. The Canadian Pacific Railway Company estimates the capital cost of conversion at $1,500,000, and would anticipate an annual operating disadvantage in the neighbourhood of $200,000.

The Canadian railways direct attention to the fact that all transcontinental lines in western mountain divisions in the United States, with the exception of one, use oil-burning locomotives, diesel electrics, or staight electric locomotives, and that the one exception, the Northern Pacific Railway, is now engaged in the conversion to oil.

In 1945 the Canadian Pacific Railway Company and its subsidiaries consumed 1,374,054 barrels of oil. For the same year the Canadian National Railways consumed 690,871 barrels of oil. Both railways secure a portion of their supply from Prairie refineries, Turner Valley in Alberta being the principal source of Canadian fuel oil. In the statistics accompanying submissions to the Commission by the railways, the Canadian Pacific Railway Company estimated that a ton of coal was equivalent to 3.75 barrels of fuel oil, while the Canadian National Railways used a lower figure of 2.5 barrels of fuel oil to a ton of coal. Both these estimates are based on operating tests and the difference between them is apparently due to variations in operating conditions and in the factors taken into account. Converting the oil consumption of each railroad into coal at its own equivalent, it appears that oil burned in locomotives displaced about 775,000 tons of coal in 1945.

In conclusion we should add that at the Commission's request both the Canadian Pacific Railway and the Canadian National Railways furnished us with submissions supplementary to their briefs, dealing exhaustively with the use of oil on mountain divisions. Copies of these submissions were furnished to all western bituminous operators and no serious attempt was made by the operators to answer the case made by the railways for their use of fuel oil rather than coal. It is quite evident from the submissions made to this Commission that neither railway contemplates now, or in the near future, any limitation on its present use of oil as a locomotive fuel.

The Bunker Market

Since 1931 Federal aid, ranging from 25 cents to $1.00 per ton, has been extended to British Columbia coal producers to assist them in meeting the strong competition from oil in supplying ships' bunkers. Bunker sales rose from 63,000 tons in 1931 to 241,000 tons in 1939. Since 1939, bunker sales have fallen sharply but this decline has been due largely to the inability of the mines to provide the coal under the short supply conditions of the war years. As from March 1, 1943, federal subsidy payments have been restricted to deliveries to tugs and other coastal shipping. Practically all of the bunker coal supplied in British Columbia has been island production, for it has been impossible for inland mines to meet the competition in the bunker market after paying rail freight. Throughout the last twelve years fuel oil deliveries in the province for bunkering purposes have been more or less regular at about 60,000,000 gallons annually, or the equivalent of approximately 400,000 tons of coal. It should, perhaps, be mentioned here that a substantial volume of coal, which might normally have been used for bunkering in British Columbia, was, during the war years, delivered to Russian vessels at Seattle.

The Export Market

A number of years ago the British Columbia coal producers held a very substantial export market in California and throughout most of the Pacific northwest. However, the discovery of oil in California terminated the market there and reduced it very substantially in all of the Pacific States. Up until 1929 the Great Northern Railway took substantial amounts of coal, at times exceeding 500,000 tons annually, from the Crowsnest Pass area. About that time the Great Northern Railway completed the conversion to oil-burning equipment of its mountain sections, and this market for Crowsnest Pass coal completely disappeared. There remains at present only two markets of any importance in the United States for British Columbia coal, one in the Puget Sound area centering around the City of Seattle, and the other in the vicinity of Spokane and the northern part of Idaho.

Before examining these two markets in any detail, there are a few general considerations which should be kept in mind. In the first place the State of Washington produced from 1,500,000 to 2,000,000 tons of coal annually in the pre-war years. A considerable part of this production was from mines owned by the Northern Pacific Railroad. This railroad is presently changing to oil in its mountain divisions and there is every prospect that its own coal production will be offered commercially, thereby intensifying competition in the Puget Sound area and more particularly in the Spokane area. The State of Washington imports large amounts of coal from Utah, Wyoming, Montana and Colorado. In general, these sources are at a disadvantage with the British Columbia mines in the matter of freight rates, but they are at an advantage in respect of mine prices. Moreover, the coal market in Washington is considerably reduced by the extensive use of fuel oil, hydro-electricity, and wood fuel throughout the area. Finally, although during World War II the export of Canadian coal to the Washington market increased very considerably, the circumstances which gave rise to the movements are not likely to be permanent. The Canadian Coal Controller and the United States Solid Fuels Administration for War collaborated continuously during the war period so as to satisfy demands for coal in the most convenient manner, and in order to meet the growing demand of the United States Pacific northwest considerable Canadian coal for steam raising and domestic purposes, and for bunkerage, was diverted to the State of Washington.

It has been said that the export of Canadian coal to the State of Washington is seriously restricted by State or Federal statutes or regulations preventing its use by public institutions or on public projects. The restrictions appear to be inconsequential. There is in force in the State one statute governing the purchase of commodities by public institutions which provides that goods produced in the State may be purchased when the prices for them are not more than five per cent in excess of the prices for such goods produced elsewhere, quality and service considered. Manifestly such a provision is not an effective restriction on the movement of Canadian coal into the State.

In the pre-war years the Island producers had a market for about 35,000 tons annually in the Seattle area. The market was mainly a domestic market and the chief competition came from Utah and Wyoming coal. During the war years the producers were unable to meet the full requirements of this market but it is anticipated that in the next few years they may be able to find an outlet for about 50,000 tons annually of their own production and a further 10,000

tons annually of Macleod River production. As at March, 1946, the retail prices for lump, nut and pea sizes were about the same for Island coals as for Utah and Wyoming coals.

Almost all of the British Columbia coal exported to the area of Spokane and northern Idaho comes from the Crow's Nest Pass Coal Company. The exports of this company have grown more or less steadily from 11,000 tons in 1934 to 172,000 tons in 1944. A portion of the wartime growth is thought to be only temporary, but the company anticipates a coal market of at least 115,000 tons per year in the post-war years. Small amounts of this coal have found their way into the retail trade but most of it is used by industrial consumers. A further 25,000 tons, or thereabouts, is exported annually to this area from the Alberta Crowsnest Pass area. It is believed that the British Columbia producer will continue to enjoy the major part of this Canadian export market because of the advantage which he possesses over his competitors in respect of ash content. The United States coals available for this area are higher in moisture, lower in fixed carbon and, in most cases, higher in ash than the Canadian coals and, therefore, their competition in the industrial market is not particularly feared. Nevertheless, it is considered unlikely that this market can be expanded beyond some 150,000 tons of Canadian coal in the near future.

There is also a considerable export of coke to this area by the Crow's Nest Pass Coal Company. Coke exports of this Company have grown from 7,400 tons in 1934 to 39,500 tons in 1944. It is believed that coke exports may continue to grow until a level of some 55,000 tons is reached.

CHAPTER X

COMBUSTION

This chapter deals with the use of coal and coke as fuels and the industrial, domestic, and locomotive equipment within which they are so used. District or central heating offers an alternative to the use of individual combustion units for space heating, and the experience of district heating systems on this continent is therefore reviewed in the last part of the chapter.

The most useful characteristic of coal is that under favourable conditions it will react chemically with oxygen in a process known as combustion, during which a considerable amount of heat is liberated. All coals contain some non-combustible moisture and ash, but they also contain fixed carbon and volatile matter which are combustible. The problem of coal combustion is to obtain from coal useful heat at the lowest possible cost per unit of such heat.

When coal is added to a fire in a stove or furnace, the fixed carbon and some of the volatile matter distilled off are burned in the air, called primary air, drawn through the firebed by the chimney draft. Normally the supply of primary air is inadequate to allow complete combustion of the volatiles, and additional air, called secondary air, is admitted above the firebed. If the supply of secondary air is inadequate, or if the air-gas mixture is cooled below its ignition point, or if the air-gas mixture is not ignited (which may happen if no glowing coals have been left exposed) combustible gases will be lost as smoke up the chimney leaving soot on the furnace walls and the flues. When all of the combustible matter is distilled off or burned, an ash residue remains which must be removed from time to time to leave room for fresh coal and to allow freer passage of primary air through the fire. If the ash residue has a low fusion temperature and if the fire is very hot, the residue may fuse to form a clinker which may seriously restrict the passage of primary air.

The heat losses during combustion may be classified as losses of actual heat or as losses of unburned combustible matter, that is, as losses of potential heat. Actual heat is lost by hot gases passing up the chimney and by heat radiated from the combustion equipment. Potential heat is lost by unburned combustible gases passing up the chimney and by unburned carbon passing through the grates into the ash-pit. It is a requirement of good combustion equipment that loss of actual and of potential heat be a minimum.

The gross heat value of a fuel (expressed in B.t.u./lb.) is a measure of the heat that would be generated by perfect combustion of a unit of the fuel. The useful heat actually obtained in any equipment per unit of the fuel burned can be measured, and the thermal efficiency of the equipment is usually expressed by giving the useful heat obtained as a percentage of the gross heat value of the fuel. Any hydrogen in the fuel is converted to steam during the process of combustion and the steam formed in this way, together with that resulting from the moisture content of the fuel, passes up the chimney uncondensed. The latent heat of the steam is therefore lost, with a consequent reduction in the thermal efficiency of the equipment. In determining the gross heat value of a fuel the products of combustion are cooled to room temperature and the latent heat in them is therefore recovered. If allowance is made for the loss of latent heat in determining the heat value of a fuel, the heat value arrived at is called the net heat value. The net heat value may be as much as 10 per cent lower than the gross heat value for a fuel with a high hydrogen content, such as, for example, natural gas. It may be only 2 per cent or less for a fuel with low hydrogen content such as, for example, anthracite or coke. It is an established practice in this country to express thermal efficiency as a percentage of gross heat value, despite the fact that the recovery of latent heat is not usually practicable.

The design of combustion equipment is complicated by the fact that coals vary over a wide range in their characteristics. A few of the respects in which coals vary, and the effect which the variations have on the burning properties of the coals, are described in very general terms in the following paragraphs.

(a) Volatile Content.—Combustion equipment and firing technique must ensure that the volatile matter distilled from coal is mixed with sufficient air under conditions of temperature and space to give prompt ignition and full combustion if a high thermal efficiency is to be secured. The reason that anthracite, coke and low volatile coals are said to be smokeless is that the volatile content of them is small, and even if the combustible gases driven off go up the chimney unburned little smoke is produced. As the rank of coal decreases from anthracite to about high volatile "C" the volume of combustible gases per unit of coal fired increases, and if secondary air is not supplied in the proper volume under suitable conditions the gases will pass off unburned, potential heat will be lost, and smoke will result. As the rank of coal drops below about high volatile "C", the proportion of total air that is required to burn the volatile matter declines. This drop is due to an increasing oxygen content in the volatile matter, and is associated with a decrease in smoke forming tendency. Thus both low and high ranking coals are more or less smokeless, while high volatile "C" rank coals have about the maximum tendency to produce smoke. Even these coals need not be smoky, for any coal can be burned smokelessly if it is properly fired in suitable equipment. It is seldom possible however to burn a high volatile fuel satisfactorily in equipment designed for a low volatile fuel.

(b) Caking Properties.—The tendency for coal particles to adhere together when heated varies considerably with different coals. In a forced draft furnace, as for example in a locomotive, coal which cakes is advantageous because it permits a higher draft without excessive loss of small particles up the stack. If, however, the coal cakes very strongly it may form a solid layer of coke over the firebed which will interfere with draft unless there is some provision for breaking it periodically. Some automatic equipment is designed so that it will break up any coke masses and strongly caking coals are therefore often suitable. In hand-fired domestic furnaces, however, coals that cake very strongly may be unsatisfactory.

(c) Ash Fusion Temperature.—If the temperature in the firebed rises above the ash fusion temperature of the coal used, the ash will fuse and may solidify on the grates or be projected onto the furnace walls with consequent loss of efficiency and furnace damage. For equipment in which high firebed temperature is attained a high fusion ash is therefore generally desirable, although some equipment is now designed for the collection of ash in fluid form, and for such equipment the fusion temperature of the ash must be below the temperature of the fire. Clinkers are more or less large fused agglomerates of ash and coke, and while in many kinds of equipment a non-clinkering ash is easier to remove, there are equipments which require that the ash clinker sufficiently to form a mass that can be removed from the firebed with tongs, while at the same time not clinkering so much as to form a slab that will interfere with air flow.

(d) Size of Coal.—If combustion is by natural draft a sized coal is advantageous, for fine coal may cut off the supply of primary air. Many stokers are designed to handle coal within a comparatively narrow range of sizes while other stokers will handle a wide variation in sizes although a narrow range of sizes in the coal used leads to more uniform combustion with almost any stoker. With pulverized coal burning equipment only very small particles can be used.

There are a number of other ways in which variations in the character of coals limit the range of equipments in which they can be used efficiently. The fact important to recognize is that the coal used and the equipment within which

it is used must be suited to each other. For this reason the combustion equipment installed in Canada imposes restrictions on the range of coals which will meet the country's needs. We require not simply coal, but different kinds of coal, each kind in amount sufficient for the combustion equipments which can use it satisfactorily. This rigidity can be overemphasized; in the short run there is some flexibility in all equipment and there is considerable flexibility in some equipment, while in the long run, as equipment is replaced, types more suitable for the coals most readily available may be installed. Moreover, there is at present in both Canada and the United States a trend towards the installation of more flexible equipment and research being currently undertaken will probably reinforce the trend. Nevertheless, the rigidity cannot be ignored, and it can be misleading to think of coal requirements except in terms of the equipment within which the coal is to be used.

I INDUSTRIAL EQUIPMENT

Canadian industry, exclusive of coke and gas plants and the railways, uses about one-quarter of the coal consumed in the country. The coal is used in a great many types of combustion equipment. The operating principles of the more common type are reviewed below, with some reference to their use in this country.

(a) Hand-fired Grates.—Hand-firing is commonly used only for small industrial units though there are still some hand-fired units as large as 500 to 600 horse-power[1]. In general, this method of burning coal is cheap to install but inefficient, and is rapidly being supplanted by mechanical appliances such as underfeed, chain or travelling grate, overfeed and spreader stokers, or by pulverized coal burning equipment.

(b) Underfeed Stokers.—In the underfeed stoker raw coal is forced under the burning fuel bed by a mechanically operated ram or pusher. Volatile matter distills from the coal as it rises under the burning fuel bed, and both the volatile matter and resulting coke are ignited in the fuel bed, thus facilitating smokeless combustion. Primary air is generally supplied by forced draft fans. All types of underfeed stokers are similar in principle, but may vary in size from the small single to large multiple retort units. Single retort underfeed stokers are widely used on small industrial boilers of 200 horse-power or less. In some underfeed stokers a movement of the grates helps to move the fuel away from the retort; these are adaptable to rather wide furnaces and to boilers up to 500 to 600 horse-power. The multiple retort underfeed stoker was, for many years prior to the more recent development of the pulverized coal furnace, the standard in North America for large industrial installations, especially those using a coking coal. These stokers employ a number of rams or plungers to feed coal to the retorts. The fuel usually moves from the front towards the rear of the furnace where the ash is removed. When a large grate area is provided or when the grate surface is water-cooled, low rank coals may be burned successfully. Multiple retort stokers have been installed in single units capable of producing up to 500,000 pounds of steam per hour.

(c) Chain and Travelling Grate Stokers.—The chain grate is composed of a chain with short grate bars linked together to form a continuous loop which revolves around sprockets in the front and rear of the furnace. The travelling grate is made up of keys fitted into cross bars which are linked together at each end to travel over the sprockets; the front of each key rides on the tail of the preceding one to form a moving grate with small air spaces on each side of the key for air distribution. Coal is fed on to the front end of the grate from a hopper

[1] The horsepower rating used is the conventional boiler horsepower, equivalent to the conversion per hour of 34.5 pounds of water at 212° F. to steam at the same temperature.

before it enters the furnace. An adjustable gate at the furnace entrance regulates the depth of fuel on the grate, which may vary from one and one-half inches to a maximum of twelve inches. Forced air is admitted under the active grate area through two or more wind-boxes with regulating dampers on either side of each wind-box. This permits positive regulation of the quantity of air to burn efficiently the fuel on the different portions of the grate. This type of equipment is adaptable to the use of coals having high ash content and low ash fusion temperature, and is extensively used for handling the small sizes of low rank coals which cake only slightly or not at all. In Ontario and Quebec it is used to burn small sizes of anthracite coal or coke breeze.

(d) Overfeed Stokers.—In most types of overfeed stokers the coal is fed on to the top of a sloping grate from a hopper outside the furnace. The coal is coked by the aid of a fire-brick arch which reflects furnace heat down on to the fuel bed. The coal is moved slowly either to the rear or to the middle of the furnace, the burning progressing as the coal moves down the grate. The movement of fuel is effected by reciprocating or rocking motions of the grate bars, aided by gravity. Clinker and ash collect at the bottom and are dumped or crushed, according to the design of the stoker. Overfeed stokers are adaptable to a wide range of coals and to the use of refuse fuels such as sawdust and tanbark. However, they are restricted to low burning rates if excessive loss of unburned fuel in the ash-pit is to be avoided, and for this reason few have been installed in recent years.

(e) Spreader Stokers.—Spreader stokers were first designed to copy mechanically the method of hand-firing of coal on to a grate. Modern spreader stokers have a variable feeding device so that the coal is sprinkled uniformly over the entire surface of a horizontal forced draft grate, either by revolving paddles or by air jets, to give a fuel bed of from two inches to four inches in thickness. Air is forced at high velocity through small grate openings which insures uniformity of air flow and produces turbulence above the firebed permitting the fines to be burned in suspension. With this burning method, very high combustion rates per square foot of grate have been attained. Three types of grates are available, stationary, dumping and travelling, the latter being somewhat similar to chain grates. Spreader stokers are usually restricted to smaller units but have been installed under boilers of as much as 300,000 pounds of steam per hour capacity. They can use to good advantage caking and non-caking coals with either low or high ash content. Low fusion temperature of ash is not a disadvantage as such coal can be burned with practically no clinkering due to the thin fuel beds with which they operate. Recent installations almost invariably use slack coal of three-quarter inch or less, but coal with a top size up to two and a half inches can be handled in some installations.

(f) Pulverized Coal-burning Equipment.—Pulverized coal firing, in which the coal to be burned is first reduced to dust-sized particles in pulverizers of the ball, roller or impact type, was first adopted by the cement industry and later by metallurgical industries for furnace heating, but its main use at present is in large scale boiler units. There are two general classes of pulverized coal preparation systems: one, the storage or bin system and the other the unit or direct system. The bin system was used exclusively in earlier pulverized coal installations, but it is being rapidly replaced by the direct system in which the coal is pulverized only as required and fed directly to the burners. Slack or crushed coal flows by gravity from an overhead bunker to feeders which measure the supply to the pulverizers where it is ground to the required fineness. A controlled amount of primary air, which in many installations is pre-heated to take care of moist coal, is forced or drawn through the pulverizer to carry away the finely ground coal in suspension. This pulverized coal and primary air mixture is fired directly from the mill into a burner located at the entrance to the furnace. The volatile matter is almost instantaneously distilled from the dust, and is burned

rapidly due to the turbulence created by the burner design. A secondary air supply is introduced, usually around the burner, to complete combustion. As there is no fuel bed, the coal must be consumed in suspension in the combustion space. This method of burning coal has been vastly improved, particularly in the past ten years. A pulverized coal-fired installation may be limited to the kind of coal for which it was designed; however, the intensive study given to operating difficulties has resulted in the development of modern installations capable of highly efficient utilization of fuels ranging from anthracite to lignite. Pulverized coal equipment is becoming increasingly popular for boiler installations of 50,000 pounds or more of steam per hour capacity.

In the winter of 1945-46 a survey was made of industrial combustion equipment installed in Canada. The survey was not complete but it is estimated that in the equipment covered by the following table about 85 per cent of the coal used for steam raising in a normal pre-war year was consumed.

	No. of Units	Total Horse-power	Average H.P. per Unit	Coal burned as per cent of Total
Hand-fired Grates	4,065	328,000	80	13
Underfeed Stokers	3,343	456,000	140	34
Chain and Travelling Grate Stokers	506	202,000	400	12
Spreader Stokers	196	68,000	330	5
Pulverized Coal Burners	170	155,000	910	35
Overfeed Stokers	83	17,000	200	1
Totals	8,363	1,228,000	150	100

A review of these data on a geographical basis shows a relationship between the type of equipment, the coal available, and the industrial needs in any area. In Nova Scotia and New Brunswick for example, more than half of the coal used by industries, excluding coke and gas plants and railways, was burned in pulverized coal-burning equipment, due largely to the fact that such equipment is particularly suitable for large thermal-electric generating stations, and to the fact that Maritime coal is suitable for such equipment. In Central Canada many plants have been designed to use coal of low volatile content and high ash fusion temperature. Coal of this kind has been and continues to be available from the United States. These plants will not operate efficiently at high loads with high volatile coal of low ash fusion temperature, and are, therefore, not suitable for Nova Scotia coal. In western Canada, spreader stokers and chain grate stokers are more common than elsewhere, largely because of their suitability for the weakly caking or non-caking character of much of the coal mined on the Prairies.

There has been increasing recognition in recent years of the fact that efficient combustion equipment, particularly equipment able to use efficiently a wide range of coals, can make a material contribution to lower fuel costs. There is, for example, a trend toward the increased use of coal with an ash fusion temperature below 2300° F. Most Nova Scotia and New Brunswick coals, as well as many United States coals, are in this category and new plant installations in the areas where these coals are available are generally designed for their use. Consideration has also been given to the design of plants to use coal high in moisture; this development is of particular importance in Canada where coals as delivered tend to be somewhat high in moisture content due to long exposure to the weather during storage and handling. The relatively high cost of coal in Canada has resulted in increased attention being given to heat recovery apparatus, such as economizers and air pre-heaters. There is also a trend toward the more careful matching of steam-generating and fuel-burning equipment.

A good deal of both fundamental and engineering research to improve the efficiency of coal utilization is being carried on both in Great Britain and in the United States, with the activities of the British Coal Utilization Research Association outstanding in the United Kingdom, and those of Bituminous Coal Research Incorporated in the United States. Both these organizations frequently issue bulletins reporting on the success achieved in their laboratories and experimental stations on a wide variety of combustion problems.

Coal research in Canada has been largely fundamental in character, and has been carried on mainly by the Fuel Research Laboratories of the Dominion Government. Some coal operators have displayed considerable enterprise in providing engineering assistance in the installation of equipment suitable for their products. Both Saskatchewan and Alberta operators, the latter being assisted by the Alberta Government, have had considerable success in enlarging their markets by this means.

II DOMESTIC EQUIPMENT

Somewhat more than one-quarter of the coal used in Canada is sold at retail prices. For the most part this coal is used in domestic heating or other small combustion equipment. There are many kinds of small combustion equipment, but they are mainly modifications of three types;

(a) Stoves.—Stoves burning either coal or coke are normally used for space heating or cooking purposes. The fire pots are fitted with shaking grates and the delivery of heat is regulated manually by undergrate and chimney dampers. Stoves are usually hand-fired, but a small number of magazine self-feeding types are used with sized anthracite or coke.

(b) Hand-fired Domestic Furnaces.—Most of the domestic furnaces used to supply warm air, hot water, or low pressure steam for space heating are hand-fired and have shaking grates. Some hand-fired furnaces operate with forced draft supplied by thermostatically controlled blowers. In such cases the shaking grates are usually replaced by stationary grates with smaller air openings, and ash removal depends on the clinkering of the ash so that it may be extracted by clinker tongs.

(c) Domestic Stokers.—Stokers of the underfeed type for domestic use are made for both bituminous and anthracite coals. The present bituminous stoker is generally of the clinker type, where the ash in the form of clinker is removed from the grate by tongs. Such a stoker is most suited for fuel with an ash fusion temperature of from 2000° to 2400° F. Coal for these stokers should not be too strongly caking for coke that forms in the firebed burns less readily than uncoked coal and is, therefore, liable to accumulate unburned as a coke tree. The coke tree may rise up through the firebed to a considerable height before it topples over, thus interrupting the regular and complete combustion of the coal. Popular sizes of coal for the clinker-type bituminous stoker are seven-eighths to three-eighths inch for the larger, and three-eighths to one-eighth inch for the smaller domestic sizes. Anthracite-burning underfeed stokers include the ash removal type where the ash collected in the furnace is removed and carried to ash cans by screw conveyers, and the non-ash removal type where ash wiped off the outer edge of the retort by revolving "fingers" falls into an ash-pit to be removed manually. Anthracite for these stokers is usually closely sized in the buckwheat range of sizes. The ash should be of high fusion temperature (2600° F. or higher) to give a light ash and little clinker. Most types of underfeed stoker have been designed and constructed in the United States for specific fuels and their use is most general in those areas, principally Ontario and Quebec,

where such fuels are obtainable. Nevertheless, underfeed stokers are used satisfactorily in other areas and with other coals. An overfeed type of domestic stoker is also in use but it is only suitable for the more free-burning sub-bituminous and lignite coals found in western Canada. Here the coal is fed on to, and travels across, a small grate through which air is forced, the ash residue falling off the back of the grate into a container in or below the furnace. The ash fusion temperature is less important with this stoker, but the coal should not form so strong a clinker that it bridges the furnace and obstructs the flow of coal. As in underfeed stokers, sized coal is burned.

According to the records of The Stoker Institute of Canada about 37,000 stokers of domestic size are installed in Canada. It is estimated that less than 10 per cent of the bituminous coal, and only 1 per cent of the anthracite consumed in domestic equipment, is stoker fired. It appears, therefore, that most of the retail trade in coal is in coal to be used in hand-fired equipment.

Perhaps the most serious objection to hand-fired domestic equipment is that unless it is provided with suitable coal, a good deal of smoke and soot may be produced. Although good firing technique can reduce substantially the smoke produced, it is extremely difficult to burn smokelessly high volatile coal in normal hand-fired domestic equipment. This is the main reason why it is that in Central Canada anthracite, coke and low volatile coals make up the bulk of retail sales, while in western Canada sub-bituminous and lignite are the coals generally used for domestic purposes.

Research in domestic coal-burning equipment is directed toward the development of smokeless stoves and furnaces, and improved means of mechanical firing. Development work on furnaces, started by Professors Fellows and Myles of the University of Illinois about 1936, has progressed to the point where manufacturers are ready to place an improved furnace of their design on the market. This furnace utilizes the down-draft principle where the volatile matter driven off the coal by heat must pass through the incandescent fuel bed and mix with additional air before entering the combustion space. All tarry products distilled off are thus consumed with the result that there is no smoke or soot formed to coat the heating surface. Equipment built by a Cincinnati firm has been on field trials for several winters and shows promise. It holds 700 pounds of coal, or approximately two weeks' supply, and is thermostatically controlled by a new type of draft arrangement. At the Battelle Memorial Institute a principle of smokeless combustion has been developed which can be applied not only to space heaters but also to cooking ranges and to furnaces. This principle has been built into practical heaters not only in the laboratory, but also by several stove manufacturers, and it is anticipated that these will be available to the public at an early date. One Canadian stove manufacturer in eastern Canada has a space heater which has been tested by a leading coal company in field trials and found to be very satisfactory. Production is proceeding as fast as materials can be obtained, and further development work is in hand. Bituminous Coal Research Incorporated has two stokers under development at the Battelle Memorial Institute which are designed to burn all types of bituminous coals with mechanical ash removal. Research has also been carried on to overcome the trouble of coke tree formation. Two recent developments, one at the Pennsylvania State College and the other at Battelle Memorial Institute, appear to have solved the problem of coke tree formation. The first accomplishes the purpose by the principle of pre-oxidation of coal which decreases coking tendencies through the admission of air below the zone in which the coal becomes plastic. The second, an inverted underfeed type with coal and air flowing downward, prevents the formation of large masses of coke by the application of mechanical forces at the time that the coal is in the plastic stage. Tests indicate this stoker capable of handling coals with a wide range in coking properties. Both operate also with the removal of the ash in a dry fine state, which can be conveyed to a receiver automatically.

The anthracite industry, through the Anthracite Institute, is carrying on research in methods of burning domestic sizes. Intensive effort is being expended to complete development of an entirely new burning equipment known as the Anthratube. Field trials are now underway, and show some progress. The principle of operation is simply the feeding of sized anthracite by means of a screw in a water-jacketed tube; forced air is admitted, flowing counter to the movement of the coal, and produces very high burning rates. The ash residue is expelled from the opposite end of the tube into an ash pocket for removal. The very high rate of combustion permits the use of a small tube, which does not require the space presently used by the standard furnace and underfeed stoker.

The convenience and comfort of space heating through the use of oil or gas have presented the coal producer with severe competition. Nearly all of the research being conducted is aimed to provide equipment which is both cheaper and easier to operate in order that coal may compete more successfully with alternative fuels in the domestic heating market

III LOCOMOTIVE EQUIPMENT

About one-quarter of the coal consumed in Canada is used in railway locomotives. In the years prior to World War II close to 60 per cent of the bituminous coal mined in Alberta and British Columbia and approximately 25 per cent of the coal mined in Nova Scotia and New Brunswick was purchased by the Canadian railways, largely for locomotive use. The coal consumption of the two largest Canadian railways for selected years is given below. The figures include coal consumed in stationary plants, but nearly 90 per cent of the Canadian coal and nearly all of the United States coal was used in locomotives.

Year	Canadian National Railways	
	Canadian Coal	U.S. Coal
	Tons	Tons
1930	2,466,000	1,990,000
1933	2,223,000	1,020,000
1937	2,605,000	1,304,000
1945	2,169,000	4,504,000

Year	Canadian Pacific Railway	
	Canadian Coal	U.S. Coal
	Tons	Tons
1930	1,856,000	1,760,000
1933	1,503,000	1,026,000
1937	1,768,000	1,131,000
1945	2,177,000	3,038,000

The steam locomotive of today is a refinement of the "Rocket" designed and built by George Stephenson in 1829. The main features of the "Rocket" were a horizontal fire tube boiler, an exhaust blast, a reciprocating non-condensing steam engine, and a direct coupling of the moving parts to the driving wheels; these are the main features of most locomotives in use today. The thermal efficiency obtainable from such equipment is limited, but major improvements

have been effected in the modern reciprocating steam locomotive. The modern coal-fired locomotive is much more powerful and operates more efficiently than the locomotive built prior to World War I, due in part, to the following improvements:

Fire Tube Super-Heaters—have allowed the use of super-heated steam, thereby increasing the power obtained from each pound of coal consumed;

Brick Arches—have been responsible for substantial savings in fuel through permitting better combustion conditions in the fire-box, thus increasing the evaporation per pound of coal consumed;

Feed Water Heaters—have decreased fuel consumption through the use of part of the waste heat in the exhaust steam to heat the water when it is taken from the locomotive tender and before placing it in the boiler;

Thermic Syphons and Circulators—which are now being used by many railways have added to the steam-making capacity by providing more heat absorbing fire-box surface;

Stoker-firing—has made possible coal-firing at the higher rate required by the larger and more powerful locomotives;

Combustion Chambers—have increased the volume of the combustion space and provided additional heating surface;

Valve Gear—improved valve gears have been developed, utilizing the steam from the boiler more efficiently, thereby saving fuel;

Water Treatment—through the use of various techniques for water treatment, boilers have been furnished with purer water, which reduces the cost of locomotive maintenance and results generally in fuel economy.

Improvement in locomotive design has over the years effected a marked saving of locomotive fuel. In 1920 the Canadian Pacific Railway Company used 148 pounds of coal per thousand gross ton miles for freight trains and 262 pounds per thousand gross ton miles for passenger trains. The comparable figures for later years are:

Year	Freight Trains	Passenger Trains
1925	120	225
1930	113	179
1935	109	185
1940	97	181
1944	105	182

Figures of pounds of coal consumed per thousand gross ton miles for the Canadian National Railways freight service for a few years are:

Year	Freight Trains
1925	140
1930	130
1935	127
1940	118
1945	114

The improvement in locomotive efficiency since 1923 admits of a graphic illustration. The Canadian National Railways advised this Commission that, if locomotive efficiency had remained at the 1923 level, that railway would have required in 1944 two million more tons of coal than was actually consumed in that year.

Diligent efforts are currently being undertaken to make further improvements, and only recently the Pennsylvania Railroad has placed in operation a coal-burning locomotive powered by a steam turbine geared directly to the driving wheels. Actual operating tests of this locomotive, the first of its kind to be built on this continent, give promise of success. This railroad now has in the process of development a 9,000 horse-power geared steam turbine coal-burning locomotive for use in passenger and freight service. The Baldwin Locomotive Works is now building three 6,000 h.p. turbine-electric stoker-fired locomotives for the Chesapeake and Ohio Railway Company. No such locomotive is in operation on any railroad on this continent today. However, the builder claims that in uniform flow of power at all speeds it will match any self-contained motive power unit now operating on rails.

Under the auspices of some of the railroads and coal operators in the United States, extensive research is being carried on to determine the possibility of perfecting a gas turbine locomotive using the combustion gases produced by burning pulverized coal to drive turbines, which in turn deliver power to the driving wheels either directly or through a generator-motor combination. This research is being followed with interest, especially by producers of coal, since the perfection of any such design should do much to meet the competition from diesel power.

At this time new ash pan designs to permit directional undergrate air flow are being tested by some of the Canadian and American railroads. It is claimed that reduced consumption of coal is effected by improved combustion of the coal particles in the furnace and by decreased loss of unburned cinders through the stack, and that the decreased emission of stack cinders will reduce the contamination of the road ballast, reduce fire hazards, and increase the availability of locomotives.

There has been considerable increase in the use of diesel locomotives on American railroads. The Chicago, Burlington and Quincey and the Santa Fe and Rock Island railroads are, in the passenger field, largely powered by diesels. Atlantic Coast Line and Seaboard, as well as a number of other American railroads, also operate diesel passenger locomotives. Of locomotives on order by Class I railroads in the United States as of September 1, 1945, 63 per cent of freight and passenger locomotives and 100 per cent of switch locomotives were diesels.

It is clear that diesel locomotives are offering keen competition to steam locomotives for both road and switching service. The main advantages of the diesel appear to be lower maintenance costs and a higher availability factor. Also, the diesel consumes fuel only while in use and there is no problem of providing it with water. On the other hand, the initial cost of a diesel locomotive is about twice as great as of a steam locomotive, measured on a horsepower basis. Availability is of no advantage unless it can be utilized, and utilization is one of the chief factors taken into consideration by mechanical officers on the Canadian railways in selecting the type of motive power to be purchased. Train schedules cannot always be arranged to permit of maximum utilization and, if the utilization is low, the interest on the capital investment has a considerable bearing on the cost per mile of operation. At present steam locomotives are considered more desirable than diesel locomotives for use in road service under Canadian conditions. The use of diesel locomotives in Canada has been limited to the switching field where they have proved more efficient than steam locomotives, and it is likely that their use for that purpose will be extended.

It may be that the increase in the size and efficiency of coal-burning locomotives may not proceed at the same rate as in recent years; nevertheless, there is still an opportunity for fuel economy by the replacement of older loco-

motives with the modern units. The following table shows the age of locomotives in use by Canadian railways:

More than 20 years old	3,326
More than 10 years and less than 20 years old	326
Less than 10 years old	473

These figures indicate that replacement will be necessary which will effect further economies in the use of fuel.

The improvement over the years in the thermal efficiency of coal-burning locomotives has been due in part to the use of better prepared coal. It is widely recognized that coal for locomotive use should contain no more than a limited percentage of smaller sizes, the percentage depending upon the kind of coal, the operating conditions of the railway, the design of the locomotives, etc. The disadvantage of smaller sizes is that under forced draft many of them are blown out the stack unburned and the heat value in them is wasted. A low percentage of ash also contributes to efficiency, for it permits more rapid combustion and cuts down heat losses through ash removal. The sizing of coal and its washing to reduce ash are both parts of coal preparation, further details of which may be found in the chapter Mining Methods. The preparation of coal is normally done by the mine operator and is his contribution towards more efficient utilization of his product.

Increases in the thermal efficiency of locomotives are paradoxically both the friend and the foe of bituminous coal production. Greater efficiency in the use of coal assists it to compete more successfully with other fuels, even though at the same time it reduces the demand. In the long run, coal operators have a vital interest in providing the market with a well prepared product and in sponsoring technical improvements, for by so doing they increase the chances for the continued use on a large scale of coal as a locomotive fuel.

IV DISTRICT OR CENTRAL HEATING

The term "central heating" has two meanings. In Europe it generally connotes one heating plant providing heat throughout a building without reliance on grates or stoves located at the point where heat is required. On this continent central heating is generally understood as a system whereby heat is produced in a central plant and conveyed in the form of steam or hot water by pipes to a group of buildings. This group heating is quite commonly called "district heating"; in this report the terms "district heating" and "central heating" will be used interchangeably.

The business of producing and distributing steam for heating and power purposes was first successfully undertaken in Lockport, New York, during the late 'seventies, prior to the introduction in 1880 of warm air and hot water furnaces for domestic heating. Domestic heating equipment has been much improved since 1880, but even yet, wherever it is necessary to use a solid fuel for the heating of dwellings, coal storage space is required, the fire demands periodic attention, ash removal is an inconvenience, and dirt and smoke may be a considerable nuisance. For these reasons heat piped under thermostatic control from a central plant is very desirable in climates having seasons where continuous space heating is necessary.

In district heating, steam or hot water is generated or produced at a central plant and piped to consumers. Many of the earlier plants were combined with installations for the generation of electricity by steam, the steam exhausted from the turbo-generators being conveyed to the consumer. Many plants

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of this character are still found and are being extended, while other plants have been developed to generate steam for district heating purposes exclusively. Some systems are a combination of both, the supply of exhaust steam being supplemented by live steam. Rather large mains are required for low pressure exhaust steam and, depending on conditions, small high pressure pipe lines may prove more economical. In some of the earlier installations the buried pipe was encased in a segmental wood log conduit. The modern practice is to have the buried pipes insulated and enclosed in an outer protective tile or concrete conduit. Under any system, insulation and proper drainage are essential to reduce transmission loss from radiation or condensation. On this continent, the mains are often laid out in a grid or a loop pattern, with connections at cross points in the line; this helps to maintain the pressure over the system and provides some insurance against loss of service in the event of a breakdown on any part of the transmission system. The use of small mains of about 3 inches to 2 inches in diameter, with three-quarter inch service connections, is being advocated, the steam being delivered from the heating plant at a pressure of about 100 to 150 pounds per square inch so as to maintain a high velocity in the main, the resulting high pressure drop having the effect of super-heating the steam and reducing condensation loss to a minimum. The mains are usually laid in the streets or alleys, but sometimes through the basements of the buildings served. In residential areas they are generally buried under the grassways, so that repairs will not disturb paved streets.

Metering of heat delivered usually follows one of three patterns, depending on the individual heating system. For low pressure steam it is usually measured by metering the condensate, for high pressure it is usual to meter the steam flow, while for hot water it is usual either to meter the temperature drop or to contract on keeping the space at a fixed temperature, the calculated heat loss determining the cost. The steam or hot water can be used in conventional standing, concealed, or base-board radiators, radiant heating, or by the use of heat exchangers to supply forced warm air filtered and humidified.

The location of the district heating plant must be carefully considered to take into account the following factors:

Shortest possible distance from plant to centre of steam demand consistent with land values and cost of steam mains,

Cost of feeder lines and best use of cross connections to form grid or loop system,

Facilities for coal and ash transportation;

Often a railway siding is a desirable location; nevertheless, coal can usually be transported more cheaply than pipe lines can be installed.

Land values,

Possible combination with existing electric power.

There is much material on the subject of district heating, and this report will not attempt a too technical review thereof. In 1919 C. A. Magrath, the Fuel Controller, devoted some space in his final report to discussion of its advantages, but the optimism underlying some of his comments has hardly been realized in the intervening years. In 1923 F. A. Combe prepared for the Dominion Fuel Board an informative study on central heating in Canada and the United States. Technical data can be secured through the National District Heating Association, Pittsburgh; the Bituminous Coal Research Incorporated, also of Pittsburgh; and the Battelle Memorial Institute of Columbus, Ohio; the latter two being engaged in research on the subject.

In the United States there are many systems supplying steam to commercial and factory areas. For example, uptown and downtown New York are widely served by a large utility with four central heating plants. Similarly, sections of populous centres such as Philadelphia, Indianapolis, Rochester, N.Y., Pittsburgh, Detroit, St. Louis, Dayton and Portland, Oregon, having heating systems. This development in business areas has been possible because the buildings supplied are relatively close to the central heating plant, and the total capital outlay for the steam plant and transmission lines is kept to a minimum for the steam put through the system. A system serving a residential area does not enjoy the same density of load and, as a consequence, is confronted with an investment in distribution lines disproportionate to the amount of steam that can be sold. Advocates of residential district heating counter with the observation that to some extent similar factors of load density and transmission loss are met with in the distribution of gas, water, and electricity to residential areas, but the comparison may disregard physical and engineering factors rendering conduit construction considerably more expensive. Research has suggested that systems employing high pressure steam with small pipes will reduce the capital investment and prove economically sound in built up residential areas, and the soundness of this idea will no doubt ultimately be tested by some installations. People naturally desire to buy heat comfort, and the maximum is certainly provided by district steam heat, but any heating project must compete with other methods of heating and the charge for comfort alone must not be too much higher than the cost entailed in the firing of furnaces either manually or by automatic equipment. Up to date it would appear that the public has not fully evaluated the intangible and indirect benefits of residential group heating.

Some of the advantages of heat generated in a central plant are:

Saving in plant investment, labour inconvenience and heating plant space,

Avoidance of coal and ash handling,

Cleanliness and better control of building temperature,

Elimination of smoke, particularly in congested commercial areas,

Reduction of fire hazards.

There is considerable institutional heating in Canada by central plants. To mention a few of them, they are—University of Toronto; Parliament and other Government buildings in Ottawa; University of Alberta; McGill University in Montreal; Dalhousie University; Toronto Terminal Railway Company, serving the Union Station, Royal York Hotel, federal and other buildings. In most cases these buildings are under one management, and none of them may present economic problems entirely comparable to those where heat is metered to a large number of individual patrons. In a report of this character some particulars of systems in Canada and the United States selling steam to the public may be of value, and render more readable our concluding comments on technical and economic aspects. A few systems in the United States will be dealt with, followed by details of the principal Canadian systems. To the reader unfamiliar with this subject, attention should be directed to some cardinal factors. Boiler efficiency is important and may reach a level of 85 per cent, although efficiency to 75 per cent should be regarded as good. The transmission loss involved, being a recurring expense, is of particular significance because the financial success of the operation is dependent on the return from delivered and paid-for steam. The ratio of capital to revenue which, generally speaking, should be 4 to 1 (or less) should be noted. Other factors must be weighed, but it is thought desirable at the very outset to stress the specific relevance of these factors.

DISTRICT HEATING SYSTEMS IN THE UNITED STATES

Overbrook Steam Heating Company

Overbrook is a suburb of Philadelphia, and this company started in business in 1893 with ten customers and now serves 1,570 homes and buildings in a residential district. The operation is exclusively one supplying steam for space heating purposes. The steam plant is architecturally in keeping with the amenities of a residential district, with a total of 3,753 boiler horse-power, and with a maximum capacity of 229,000 pounds of steam per hour. This steam, at low pressure, is fed to mains varying from 12 inches to 2 inches, with a total length of approximately 14 miles. The fuel used is customarily either barley anthracite or bunker "C" oil. The fuel cost appears to be 3.03 cents per thousand pounds of steam generated, and the overall cost for the same quantity of steam, including all operating costs and depreciation, without a return on the investment, is 57.4 cents. The plant boiler efficiency is 69 per cent, and the transmission loss is 23 per cent. For their fiscal year 1944-45 the revenue was $267,000, giving a revenue per thousand pounds of steam of 97.7 cents. The ratio of present capital to revenue is 2.93 to 1. This utility is in a healthy financial position having paid dividends for the past fifteen years after taking full allowable depreciation and creating reserves for future capital expansion. In addition, the company is entirely free from debt, bonded or otherwise. Having regard to the vicissitudes of district heating, particularly in areas lacking a commercial density of load, the steady progress of this company over a period of fifty years is significant.

Detroit Edison Company

District heating started in Detroit in 1903, combining a system of steam electric generation with utilization of exhaust steam for heating purposes, with a view to improving overall plant thermal efficiency. From this beginning the utility has expanded to four boiler plants serving 1,755 customers over an area in the heart of the city, apout 3.25 miles long and varying in width from one block to nearly one mile. The total horsepower of the boiler plants is 39,235. The mains vary from 20 inches to 4 inches throughout the area described, the larger mains in the downtown area being carried in tunnels 25 to 60 feet below street level, for a total length of 2.5 miles. The steam is sold on a guaranteed low pressure basis to the consumer and is produced exclusively with bituminous coal. The average of the boiler efficiency of the various plants is 77 per cent to 80 per cent, and distribution loss averages about 15 per cent. The gross steam earnings, reaching the substantial amount of $2,500,000 annually, is stated by the management to be an inadequate return on capital. This utility has found the competition of the isolated boiler plant particularly severe in the case of apartment buildings and hotels. The service to small customers is popular but the cost of underground mains is out of proportion to the amount of steam which can be sold in an area of detached residence or other small buildings, thus making the fixed charges more than the business can ordinarily carry. Experience in Detroit has demonstrated that the economy of the large central boiler plant, in comparison with the wastefulness of the domestic furnace or hot water boiler, does not always counterbalance the greater investment cost.

Duluth Steam Corporation

This utility started in 1932 for the purpose of generating steam exclusively for industrial and space heating purposes, and the system now serves an industrial, commercial and residential area. Though started at the inception of the depression of the 1930's, and suffering thereby, it has now emerged with its generation equipment loaded to 75 per cent of operating capacity. There are 253

customers; 15 per cent of the steam generated is used industrially and the balance for space heating. The plant has an installed boiler horse-power of 3,400. High pressure steam at 150 pounds is delivered to mains varying between 18 inches and 2 inches in diameter, the main system having a length of 6 miles. Coal is used exclusively as fuel; the cost per thousand pounds of steam is 33.3 cents and the revenue 84.8 cents. The boiler efficiency is approximately 75 per cent, and operating statistics would indicate that transmission loss is between 16 per cent and 18 per cent. The total investment in this plant is in the neighbourhood of $1,500,000 and for the fiscal year 1944-45 operating revenue was $484,000, making the ratio of capital to revenue 3.1 to 1. The base rate, or first block charge, is 97 cents per thousand pounds in winter and 82 cents in summer. This operating, starting under unfavourable circumstances, has made considerable progress and has reduced fixed liabilities to something in the neighbourhood of $230,000. It has managed over the period of its life to earn depreciation and has met all bond interest. As yet, no dividends have been paid to stockholders.

The City of Virginia, Minnesota

Virginia, a city in Minnesota, with a population of 13,000, is of particular interest in that it is probably the only community on the continent wholly served by a district heating system. The service is combined with that of supplying electricity, water and gas. The system began back in 1913 when the city bought a privately-owned waterworks and electric plant. This was later expanded in 1929 by taking over a lumber mill which supplied cheap steam and electric power to the community. Improvements were made until today the system is a fairly modern one with adequate generating facilities for electric power and steam heat. The installed boiler horse-power totals 5,518, with the steam passing into the mains either directly or through turbo-generators. The gross income from the sale of district steam for the fiscal year ending September, 1944, was $353,000. This municipal utility has always operated at a net loss when depreciation is included, being content as a municipal enterprise to operate on a non-profit basis. As the municipality virtually combines in one operation all the services commonly present in a modern community, differences of opinion can arise as to charges properly assignable to the district heating division. It is commonly stated, however, that space heating costs throughout this community are lower than costs in adjacent communities not having a utility of this character.

As was stated earlier, there are numerous district heating utilities in the United States, and the Commission gratefully acknowledges operating data furnished by the following utilities: New York Steam Corporation; Rochester Gas and Electric Corporation; Union Electric Company of Missouri; Central Heating Company of Eugene, Oregon; Northwestern Electric Company of Portland, Oregon; Consolidated Gas, Electric Light and Power Company of Baltimore; Western Massachusetts Electric Company of Pittsfield, Massachusetts. Some of these operations are similar to those described in more detail above. In many instances electric generation is combined with the steam service. It would appear that most of the utilities serving commercial areas are operating profitably, which gives rise to the current interest in the possibility of district heating being given general application to residential areas.

DISTRICT HEATING IN CANADA

Mention has already been made of institutional heating in Canada. District heating proper was first attempted in the town of North Battleford, Saskatchewan, where exhaust steam from an electric steam generating plant was utilized to heat commercial buildings and a few residences. This utility is

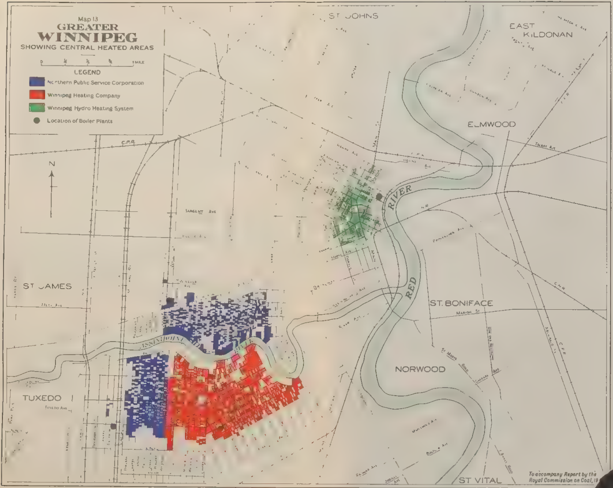
municipally owned, presently servicing 130 customers including 25 residences. Its relative success is probably explained by the fact that the cost of the entire distribution system was defrayed from current revenue. The city of Brandon, Manitoba, is another pioneer example of limited district heating development; this plant was established over twenty years ago, serving principally a commercial area with 190 customers. The utility is distinctly unprofitable; its operating costs are not being earned. The city of Winnipeg has three steam heating utilities—one, the Winnipeg Hydro Electric System (Steam Division) serving downtown Winnipeg, and two residential operations, the Winnipeg Heating Company and the Northern Public Service Corporation Limited, now under joint operating management. Appended, herewith, is a map showing the location of these three systems. London, Ontario, also has a steam heating system. Detailed information of the Winnipeg and London systems will follow.

Winnipeg Hydro Electric System—Steam Division

To overcome the interruptions caused by severe storms that affect transmission lines from hydro electric plants, a steam standby plant was completed in 1924. The plant was designed to provide district heating during the winter months when the likelihood of interference with transmission power lines is at a minimum. The system was expanded until today there are 284 customers being served in the downtown area of the city, which is exclusively commercial. The plant has a total installed coal-fired boiler horse-power of 6,650 and three electric boilers of 7,500 kw. each. The steam is fed at low pressure to the steam mains, which vary in size from 14 inches to 4 inches and have a total length of nearly 6 miles. Two-thirds of the required energy is furnished by off-peak and some peak hydro power and the balance by coal, about 13,000 tons annually, giving an average combined cost of fuel per thousand pounds of steam equal to 38.3 cents. The efficiency of the steam boiler is about 70 per cent, depending on load conditions, and the transmission loss in the mains is approximately 26 per cent. Revenue from the sale of steam heat for the last fiscal year totalled $431,000, or an income of $1.07 per thousand pounds of steam sold. The capital investment to date is $1,527,000, giving a ratio of capital to revenue of 3.55 to 1. Net bonded indebtedness as at the end of 1945 was $250,000, in which year a net profit of $50,000 odd was made. This utility, in addition to revenue from the sale of steam, receives $25,000 annually for its standby service to the hydro system and has the advantage of a high density of load, identification with a hydro electric system, and the availability of cheap off-peak hydro electric power.

Winnipeg Heating Company

This system (privately owned) was established in 1929 and now serves 1,600 customers. Its one steam plant contains an installed horse-power of 3,800, with an efficiency of 70 per cent and a 10,000-kilowatt electric boiler, the latter using off-peak power. The system consumed in 1945 a total of 7,500 tons of coal, 1,400,000 gallons of oil, and 42,000,000 kilowatt hours of energy, with a combined fuel cost of 50 cents per thousand pounds of steam. This steam is fed into distribution lines varying in diameter from 12 inches to 3 inches, with a total length of about 20 miles. Transmission loss of steam mains is 40 per cent. Capital cost of installed equipment totalled $1,000,000. The average rate received for steam is $1.44 per thousand pounds, giving a revenue in 1944 of $366,000 and a ratio of capital to revenue of 3.66 to 1. This system serves an exclusively residential area with many detached dwellings. The low load density, long transmission mains, and climatic conditions probably account for the high line loss.


Map 13
GREATER
WINNIPEG
SHOWING CENTRAL HEATED AREAS
LEGEND
Northern Public Service Corporation
Winnipeg Heating Company
Winnipeg Hydro Heating System
Location of Boiler Plants
N
ST JOHNS
EAST
KILDONAN
ELMWOOD
RIVER
RED
ST JAMES
ST. BONIFACE
NORWOOD
TUXEDO
ST VITAL
C.P.R.
SARGENT AVE
MARION ST
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Northern Public Service Corporation Limited, Winnipeg

This utility was likewise started in 1929 as a private company and now serves 1,740 customers in a residential area. District steam is supplied from two steam generating plants with an aggregate boiler horse-power of 5,300 operating at an efficiency of 70 per cent and one 10,000-kilowatt electric boiler. Energy consumed in 1945 totalled 24,750 tons of coal, 350,000 gallons of oil, and 60,000,000 kilowatt hours of electricity. The combined fuel cost is 71 cents per thousand pounds of steam. The mains, distributing steam at 75 to 40 pounds, are 30 miles in length and vary in diameter from 12 inches to 2 inches, with a transmission loss of 25.5 per cent. Through a system of sub-stations, live steam is used for the production of hot water in certain districts where there are residences only and no apartment buildings. The base rate for steam is $1.21 per thousand pounds, giving an operating revenue for 1944 of $387,000 and, with a capital investment approximating $2,000,000, the ratio of capital to operating revenue is 5.17 to 1. Like its sister company, this utility has never fully earned its depreciation and no dividends have been paid. A desirable part of residential Winnipeg is dependent upon the service of the Winnipeg Heating Company and this utility, and many residences built in recent years have not included heating equipment or even chimneys. The operating results of both companies are discouraging.

Cities Heating Company Limited, London

The installed boiler horse-power of this utility totals some 1,600, which operates at an efficiency of 71.5 per cent. Total fuel requirements for the heating season 1945-46 were about 8,000 tons of bituminous coal, which produced steam at a fuel cost of 43.5 cents per thousand for some 275 customers. Steam is generated at 135 pounds per square inch for distribution at high pressure (125 pounds) or low pressure (5 pounds) through some 11 miles of mains varying in size from 12 inches to 1 inch in diameter, with a distribution loss of about 23 per cent. Capital investment is $431,954, which yielded a revenue of $129,215 for the year 1945-46, or a revenue of about $1.35 per thousand pounds of steam sold. Ratio of capital to revenue is approximately 3 to 1. The company earned and paid interest on its bonded indebtedness, earned depreciation, and provided a small profit on the capital employed.

PROBLEMS IN DISTRICT HEATING

In our country, heat comfort during cold weather is of interest to everyone. District heating has proved a success in many metropolitan communities on this continent. It is perhaps remarkable that congested commercial areas in Montreal and Toronto are without district heating, but there are communities of similar size in the United States where congested areas rely on individual heating plants, and the efficiency of many of these plants would present keen competition to any district heating utility. Nevertheless, there are distinct economic advantages from piped steam in a congested area, particularly when space saved and the inconvenience of fuel deliveries are evaluated, and there will probably be an expansion in district heating in congested areas as existing individual heating equipment requires replacement.

In a comparison of the cost of heating service by a district system and by an individual system, care must be taken that all costs, including fuel, labour, maintenance, insurance, amortization, interest, taxes and profit, are included for both systems. The owner of a house usually considers his heating cost as only the out-of-pocket expenses for fuel, and fixed charges on the heating plant are rarely considered. Other costs, as maintenance, ash and refuse removal, and power, ordinarily paid with other household bills, are not added to the heating cost.

When all these costs, ordinarily neglected, are included, it may be found that the total costs for individual heating are not much lower than those of a district system.

The distribution system constitutes the largest single portion of the capital cost for a district heating plant. Even in a commercial and residential area this will be in the order of 50 per cent of the total cost. Research on new methods of construction may bring the cost down somewhat, but the cost of pipelines with adequate insulation will probably always militate against the extension of pipelines for long distances from a district steam plant to outlying residential areas where, if the houses are already built, only a fraction can be counted upon to take this service, as many will already have heating plants that are modern and in good condition. This will increase the cost of pipelines per customer. One solution for the long distribution lines from commercial to residential areas is to develop heating of groups of residential dwellings, from 25 to 200 or more in number, installations being best made when houses in the area are being constructed. For the larger groups, particularly for those made up of apartments or even of smaller multiple-family dwellings, the district heating system can be conventional in design. For smaller groups, as for 25 houses in a city block, studies made by Battelle Memorial Institute for Bituminous Coal Research Incorporated show that economies can be effected that will decrease the cost of the installation and operation below those of even larger systems, by installing the heating plant in the basement or garage of one of the homes, and by the simplification of equipment.

The main operating economy of a district heating system over a system of individual domestic heating units is in the fuel cost per unit of sensible heat obtained from the heating equipment. The central plant is able to burn coal of lower rank and lower grade than can individual units; such coal is, of course, much cheaper f.o.b. mine. Because deliveries to a central plant are on a much larger scale than to individual households, most of the expenses involved in retailing small tonnages can be avoided. Finally, the thermal efficiency of the combustion equipment that would be used in a central plant is very much higher than that of individual heating units. Whether or not a district heating system is a commercial success will depend largely on whether or not the lower cost of steam raising in a district heating system is sufficient to offset the larger overhead of, and the transmission losses inevitable in, the system.

The total cost of district heating, including the fixed charges, will vary according to the system of management. One method particularly suited to small or moderate-sized groups is the division of the capital cost of the system among the properties, and vesting the management in a co-operative committee elected by the owners.

CHAPTER XI

PRODUCTS AND BY-PRODUCTS

This chapter covers all uses of coal other than as raw fuel, and is divided into three parts, the coke and gas industry, the potential synthetic liquid fuel industry and the chemical industry based on products from coal. In Canada there is a coke and gas industry and a chemical industry based in part on coal and its products. There is no synthetic liquid fuel industry, but the section dealing with this subject is presented because of the wide interest in it.

THE COKE AND GAS INDUSTRY

The coke and gas industry is based largely upon a process known as the destructive distillation, or carbonization, of coal. In this process coal is subjected to a high temperature in the absence of air, whereby it yields solid, liquid and gaseous products. These include a solid residue called coke, which is mainly carbon, three liquid products known as tar, light oils, and ammoniacal liquor, and a considerable volume of combustible gases. The coke is used in metallurgical plants for the smelting and working of metals, as a domestic fuel, for the manufacture of gas, and as a raw material for the manufacture of chemicals. The liquid products are mainly sold as raw materials for chemical industries. Part of the gas may be burned to produce the heat necessary for the carbonization process, or it may all be distributed for industrial and domestic heating.

Generally speaking, only coals of bituminous rank are used for coking, and not all bituminous coals will coke. The general public is greatly impressed with the importance of anthracite because of its widespread use as a smokeless domestic fuel, but the presence on this continent of large reserves of bituminous coking coal is of far more importance to the industrial life of the continent.

The manufacture of coke from coal has been an established industry for a matter of 200 years. Three centuries ago the iron industry in Europe was wholly dependent upon charcoal as a fuel for iron smelting and other metal working operations, but as forests were depleted investigation led to the coking of coal to replace charcoal. At one time all coal was coked by a beehive process in which the volatile elements of the coal were burned. As the wastefulness of the beehive process was recognized, new processes were evolved, known as by-product processes, under which tars, light oils, and gas were recovered from the volatile ingredients. Even yet, however, the beehive process is used and during World War II many abandoned beehive ovens were reconstructed in order to increase the supply of coke for metallurgical purposes. A related industry, that of the manufacture of gas from coal, was established early in the nineteenth century. At first the two industries were quite distinct, but as the modern by-product plant can be used regardless of whether coke or gas is the main requirement, the two industries now merge into each other.

The processes used in the coke and gas industry are somewhat complicated, and vary from plant to plant. Some plants, referred to as coke plants, are designed to make coke, with the tar and gas merely by-products. Others, called gas plants, are designed primarily to make gas, with coke and tar as by-products. Still other plants use coke instead of coal as raw material, and make only gas.

On the next page are presented a few figures on a regional basis for the coke and gas industry in Canada. The figures in this table cover 28 plants, ranging in size from that at Sault Ste. Marie, with a rated capacity of over one and three-quarter million tons of coal annually, to small gas plants purchasing coke

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COKE AND GAS INDUSTRY—SALIENT STATISTICS FOR 1937 AND 1944

—	—	Maritime Provinces		Ontario and Quebec		Western Provinces		All Canada	
		1937	1944	1937	1944	1937	1944	1937	1944
Employees	Number	390	470	3,090	3,650	550	630	4,030	4,750
Employees' wages and salaries	Thousands of $	470	870	4,500	6,950	740	1,120	5,710	8,940
Reported sales values of products	Thousands of $	4,200	7,800	33,700	56,200	3,800	5,600	41,700	69,600
Coal charged, Canadian	Thousands of tons	664	808	196	18	295	395	1,155	1,221
Coal charged, imported	Thousands of tons	....	....	2,399	4,061	26	34	2,525	4,095
Coal charged, total	Thousands of tons	664	808	2,595	4,079	321	429	3,580	5,316
Coke produced	Thousands of tons	450	590	1,910	3,130	210	300	2,570	4,020
Gas produced	Millions of cubic feet	6,540	10,300	34,950	64,800	4,520	4,100	46,010	79,100
Other products, sales values	Thousands of $	610	1,080	2,620	4,030	80	110	3,310	5,220
Coke imports	Thousands of tons	13	....	390	789	15	24	418	813
Coke exports	Thousands of tons	....	*	1	*	36	39	37	43
Estimated coke consumption;									
In three steel plants	Thousands of tons	320	430	530	1,230	....	....	850	1,660
Retail sales—domestic	Thousands of tons	60	120	1,000	1,290	90	80	1,150	1,490

* Figure not available.

and converting it into gas for a small local market. Five of these plants, located at Sydney, Sault Ste. Marie, Hamilton, Coleman and Michel, produce principally metallurgical coke. These five plants treat from one-half to two-thirds of all the coal coked in Canada. A number of other plants produce principally domestic coke and gas; examples of such plants are those at Montreal, Hamilton and Winnipeg. Most of the other plants in Canada produce principally gas, the largest of such plants being at Toronto, Ottawa, Quebec and Vancouver. In order to permit a comparison of the size of the coke and gas industry in Canada with that in the United States, we add that the total amount of all coal carbonized for all purposes in the United States was 74,500,000 tons in 1937 and 105,600,000 tons in 1944.

In the following pages we shall discuss in rather more detail the products of carbonization, the nature and availability of coal suitable for carbonization, the various processes used in the coke and gas industry, the larger plants presently operating in Canada, and the aid which has been given by the Dominion Government to the industry. The purpose of this survey is to increase understanding of the role played by the coke and gas industry in processing coal to provide suitable fuels for industrial and domestic purposes, and the potentialities of the industry as a consumer of Canadian coal.

THE PRODUCTS OF CARBONIZATION

Carbonization is a general term for the decomposition by heat, in the absence of air, of any carbonaceous substance such as coal, peat, wood or oil shale. The process is called coking only when the material treated is a coal that first softens when heated, so that the individual pieces agglomerate, and then hardens to form the cellular material called coke. Carbonization may be classified according to the temperature employed into high and low temperature carbonization as described later. The high temperature treatment of coking coal is by far the most important section of the carbonization industry in Canada.

A coking coal, like other coals, is comprised essentially of carbon, volatile matter and ash. When coal is coked the ash remains in the coke, and the volatile matter passes off more or less completely. The character of the coke varies widely with the rank of the coal, the temperature reached during coking, and the method of heating. The volatile matter as driven off is a decomposition product, and as such also varies widely in both quantity and quality with the conditions of decomposition. The yields are interrelated: if the coke yields are high, those of tar and gas must be low, and vice versa. Typical production from a ton of coal carbonized at a high temperature is 1,400 pounds of coke, 9 gallons of tar, 2.5 gallons of light oil, 12,000 cubic feet of gas and 6 pounds of ammonia.

Coke

When a coking coal is heated rapidly in the absence of air it passes through a semi-fluid state. The simultaneous decomposition of the coal, with consequent escape of gases and vapors, gives the plastic mass a cellular or porous character which it retains when further heating solidifies it into coke. The character of the coke is affected by the amount of volatile matter in the coal treated; a low-volatile coal giving a dense, hard coke, and a high-volatile coal a light, porous coke. The physical character of a coke is often all important, particularly with metallurgical coke for use in a blast furnace, where it should be strong enough to carry a heavy load. It is also desirable to be able to crush and size coke for the market without excessive production of the fine coke, called breeze. Cokes vary in reactivity, that is, in the ease with which they burn in air or are attacked by gases such as carbon dioxide and steam. A high temperature in the oven and the consequent deposition of a film of shiny, graphitic carbon on the coke by secondary decomposition of volatile matter tend to give the non-reactive

character desired for metallurgical coke. A lower temperature in the oven and a shorter time of heating will leave some volatile matter in the coke, making it a desirable, reactive fuel for domestic heating.

The mineral impurities of the coal remain in the smaller weight of coke produced; the coke consequently has a higher percentage of ash content than had the coal. Thus, if a coal containing 9 per cent ash is coked to give a 75 per cent yield of coke, the coke has an approximate ash content of 12 per cent. A low ash content for coke is often essential; a small reduction in the ash content of coke may materially decrease the coke consumption in an iron blast furnace. The coke retains some of the sulphur of the coal; this is unimportant in domestic coke but may be particularly objectionable in metallurgical coke.

When non-coking coals are carbonized the individual pieces shrink but do not soften and change shape and the solid product, called char, disintegrates. Char may have a heat value in excess of that of the coal and after briquetting be a useful, reactive, smokeless fuel.

Coke for metallurgical purposes should be clean (that is, with low ash and sulphur), of low reactivity, strong, and of good physical structure. Different branches of the metallurgical industry, however, weigh these factors quite differently. Coke for domestic use should be clean, have a high fusion temperature ash, be carefully sized, be strong enough not to break when handled, and be reactive. Coke is a smokeless fuel and is, therefore, a substitute for anthracite. The heat value of coke, as of anthracite, varies with the ash content, but normally the heat values of domestic coke and anthracite are about equal, pound for pound. The need for a reactive coke is stressed, as otherwise it is hard to maintain a low fire in mild weather. Coke suffers in competition with anthracite on account of its bulk, since a furnace that will hold a charge of 30 pounds of anthracite will hold less than 20 pounds of coke.

Gas

The gases of commerce are mixtures, in widely differing proportions, of the non-combustible gases nitrogen, carbon dioxide, and oxygen with such combustible gases as carbon monoxide (322), hydrogen (325), methane (1,013), and some others. The figures in brackets are the heat values of the combustible gases in B.t.u. per cubic foot of gas. Natural gas, which is essentially methane, has a heat value of about 1,000 B.t.u. per cubic foot. Coal gas, made by the straight high temperature carbonization of coal, has a heat value of about 600 B.t.u. per cubic foot as it leaves the oven, while gases made by the complete gasification of coal may have heat values anywhere from the 430 B.t.u. down to as low as 120 B.t.u. per cubic foot. This wide range of heat values is of far greater significance in the distribution than in the utilization of gas. The actual composition of a gas is seldom of major importance, unless the gas is to be used in the synthetic chemical industry. Gas is a premium fuel because of its convenience and efficiency of use. The chief handicap for its widespread use for space heating is the seasonal demand. Its principal market is for cooking and water heating and certain industrial heating processes.

Tar, Light Oils and Ammonia

If the gases and vapours leaving a coke oven are cooled, a watery liquid condenses. This contains ammonia and ammonium compounds and is known as ammoniacal liquor. A heavy, dark-coloured, oily liquid known as coal tar also condenses. The gas left can be further treated to obtain from it a mixture of liquid hydrocarbons known as light oils. Tar and light oils are of great importance but only as raw materials for other industries; the use of them is described in Part III of this chapter.

SELECTION AND LOCATION OF COKING COALS

Coals used in the coke and gas industry are referred to as high volatile if with over 31 per cent volatile matter in the dry coal, medium volatile if with 22 to 31 per cent, and low volatile if not above 22 per cent. These limits may vary with the locality. A high volatile coal gives a high yield of tar and light oils, and a high yield of a gas of high heat value. It may, therefore, be preferred for a plant which specializes on gas production. The yield of coke, on the contrary, is low and it is light and porous. A low volatile coal gives a far smaller yield of tar and light oils, and also a lower yield of a gas. The coke yield is greater and it may have a hard, dense structure. In practice, low volatile coal is usually blended with other coals, and coal blends are preferred. A medium volatile coal is intermediate in yields of products and in their properties; in general, it gives the best coke. The following table gives typical by-product oven yields per ton of coal treated:

—	Low Volatile Coal	Medium Volatile Coal	High Volatile Coal
Coke—			
Yield by weight, lbs.	1,700	1,500	1,360
Gas—			
Yield by volume, c.f.	9,200	10,400	10,800
Tar and Light Oils—			
Yield by volume, gallons	3.8	10.5	12.9

Many plants, particularly those which make and sell different varieties of coke, find it advantageous to stock coals of two or three different volatilities. These can be blended in different proportions to give the desired products. Low ash fusion coal may also be blended with high ash fusion coal, and a coal giving a high expansion pressure when coked blended with one that expands less to avoid damage to the brickwork of the oven.

A coking coal should be low in ash. Excessive mineral impurities are a source of weakness in coke, cause trouble in domestic furnaces, and in a blast furnace necessitate the use of additional flux, and additional coke to heat the resulting slag. For this reason an increasing proportion of the coal charged to by-product ovens is first washed to reduce its ash. A low sulphur coal is always desirable. A coking coal should store well, for coke and gas makers commonly need to carry large stores of coal to ensure continuity of supply and to permit the summer purchase of coal for winter use.

Coking coals are mined in Canada only in Nova Scotia, Alberta and British Columbia; that is, in the extreme East and West. In Nova Scotia, low ash coals which coke well are mined in the Cape Breton area. These are high volatile, or gas coals, with a high sulphur content, but are made into metallurgical coke. The steel plant at Sydney is operated on coke made there from washed local

coal. Nova Scotia coal is used in domestic coke and gas plants in Halifax, Saint John and Quebec, but it has proved difficult to extend the sale of this coal to the Montreal coke plant, with its highly competitive market. Exception was taken to the low fusion temperature of the ash because the householder, accustomed to burning non-clinkering anthracite, was unwilling to burn a coke which clinkered when the fire was forced in cold weather. Coal storage also caused some difficulty at the plant. It was found that some 35 per cent of washed coal from the Princess and Waterford No. 12 mines in Cape Breton could be satisfactorily blended with lower volatile United States coals. This, however, necessitated the expense of sending the coal through the washery of the Sydney steel plant; in addition, the segregation of any appreciable percentage of the best Cape Breton coal for a coke-manufacturing customer was prejudicial to the quality of the coal going to the coke ovens at the steel plant, and to the quality of mixed coal sold to other consumers. The Montreal company stated in their brief their willingness to use 40 per cent of the above washed coal, but added that they understood that the actual deliveries were all of such coal available. An average of 175,000 tons of coal was shipped annually to the Montreal plant in the seven years, 1935 to 1941 inclusive, but no coal in 1943 or 1944. Owing to emergency conditions created by coal and shipping strikes, the Coal Controller, during the 1946 season, diverted 75,000 tons of Nova Scotia coal to this plant for coking purposes.

Central Canada, west of Montreal, is entirely dependent for coking coal on importations from the United States. Importations include coals of high, medium and low volatile types to be blended in different proportions to meet the needs of particular plants. Thus, such a firm as the Consumers' Gas Company of Toronto will use a high volatile coal whereas the Algoma Steel Company, making metallurgical coke, will use a medium volatile blend. The difficulty experienced in supplying Nova Scotia coal for the Montreal coke plant makes it highly improbable that such coal for coking purposes could displace United States coal farther west. The large by-product coke plants at Sault Ste. Marie and Hamilton, in 1944, coked over three million tons of imported coal, and the gas plants at Toronto and elsewhere coked over three hundred thousand tons. 65 per cent of all the coal coked in Canada is treated in the part of central Canada west of Montreal.

Western Canada has low-sulphur coking coals in the mountain coal areas of Alberta and of British Columbia, and also on Vancouver Island. A high grade coking coal of medium volatile type is mined in the Crowsnest Pass area. The medium volatile coals of Alberta are also good coking coals, but have a higher ash content. They are normally washed for coking, but the ash content cannot be reduced economically below ten to twelve per cent. Low volatile coals are mined in Alberta, but these are non-coking in character, and so far have not proved suitable for blending. Vancouver Island produces high volatile coking coals, of which a large proportion of the fine sizes are carbonized in the gas plants at Victoria and Vancouver. Western coking coals are used for coking as far east as Winnipeg, and up to 50,000 tons of coke made from western Canadian coals are exported annually to the United States.

PROCESSES FOR COAL CARBONIZATION AND FOR GAS MAKING

High Temperature Carbonization Processes

Beehive Ovens

The beehive oven process is the oldest still in operation, but beehive ovens account today for less than four per cent of Canada's total carbonization capacity. The ovens are of simple fire brick construction, with a flat floor of twelve or more feet in diameter and a domed roof resembling a beehive. Coal is charged

through a hole in the roof and air is admitted in restricted amounts through a door in one side. Volatile matter, driven off by heat, catches fire and burns over the charge, thus providing the heat required to complete carbonization. Carbonization proceeds from the top of the charge downwards. Volatile matter from the lower layers passing up through the already coked, and very hot, upper layers is decomposed, depositing a silvery, graphitic carbon on the coke. This gives the coke a silvery appearance, and a non-reactive character desirable for blast furnace use. The output per oven is small, since each charge may take three days to coke. The cost of operation is high, since the withdrawal of the coke from the oven is laborious, often being done manually. Before removal, the coke is quenched in the oven with water. The beehive oven is wasteful in that the volatile constituents, and some of the coke, are burned.

By-Product Coke Ovens

By-product coke ovens are operated to make coke, with the gas, tar, etc., recovered as by-products. The recovery of by-products contrasts with the Beehive process in which the volatile constituents and some of the coke are burned. No air is admitted to the charge, and the heat required reaches the coal through the walls, from flues in which gas is burned. The gas and other volatile matter from the heated coal are removed through offtakes and suitably treated for the recovery of by-products. The heating gas used may be the gas from the process, or a less valuable gas made for the purpose. Makes of ovens such as Koppers, Semet-Solvay and Wilputte may vary in size, shape and construction, but operate on the same basic principle. A full-sized modern by-product oven is a rectangular chamber over 40 feet in length, from 10 to 15 feet in height, and with an average width of about 18 inches. The oven has removable doors at each end and a slight taper from one end to the other, to facilitate pushing out the coke at the end of each run of eighteen hours, more or less. Batteries of 60 such ovens may carbonize as much as 1,500 tons of coal per day. The standard by-product oven plant has a very high capital cost. It can be operated with great efficiency, but only on a large scale. Attempts to use smaller sizes of ovens and plants have not always been successful.

One distinct variant of the by-product oven operated in Canada is the Curran-Knowles oven. This is a flat oven approximately 40 feet long by 8 feet wide, heated by flues below the floor. The capital cost is lower than that of other by-product plants, and it can be operated on a smaller scale. It also can treat highly swelling coals without difficulty. As the coal is coked from below, the volatile matter driven off does not pass through the hot coke, and the coke produced has, therefore, physical properties rather different from that of other by-product ovens.

Travelling-Grate Carbonization

The travelling-grate carbonization process of the Shawinigan Chemical Company is a high temperature process adapted to the special operating conditions of that Company. A coking bituminous coal is fed in a layer of three or four inches thickness, onto a travelling grate, 48 feet long by 10 feet wide, moving at a speed of 80 to 90 feet per hour. The coal is converted to coke by controlled combustion supported by air supplied from blower compartments below the grate. Coking proceeds from the top downwards. A coke suitable for the manufacture of calcium carbide is thus made at low capital and operating cost. The sensible and potential heat of the products of distillation are efficiently utilized by sending these products to the rotary lime kilns, where they are burned as fuel.

Gas Retorts

A gas retort is a container usually constructed of fire brick and externally heated in which coal is carbonized. In the larger modern plants in Canada continuous vertical retorts of English design are used. These retorts are continuously charged with coal which descends through the retort as the coke is withdrawn from the bottom. The Glover-West type of retort has a carbonization capacity of about five tons of coal per day; the Woodall-Duckham type up to twelve tons per day. An important feature of all vertical retorts, and some types of chamber ovens for making city gas, is their adaptability to the introduction of steam into the base of the retort. The steam reacts with some of the hot carbon (coke) to give "water gas". This reaction not only serves to cool the coke before it is discharged, but also increases the volume of gas produced in the retort. The advantage of modern gas retorts over by-product ovens is that with them a higher yield of gas may be obtained, and smaller plants successfully operated.

Total Gasification Processes

These processes, as their name implies, are used to convert coal, or coke produced by some high temperature process, into gas. There are substantially no by-products.

Gas Producer

A gas producer is a chamber, usually of brick or iron lined with brick, into which coal or coke is charged, and through which air and some steam are blown, completely gasifying the solid fuel. The air reacts with the carbon of the coke to form carbon-monoxide, which is diluted with nitrogen from the air. The process develops a high temperature in the fuel bed. The steam blown in reacts with some of the very hot coke to form two combustible gases, carbon-monoxide and hydrogen, thereby cooling the fuel bed and enriching the gas. The gases produced by blowing both air and steam through a deep coke fire have a heating value of about 130 B.t.u. per cubic foot. If coal is used, instead of coke, the gases will be enriched by the volatile matter from the coal.

Water Gas Generator

A water gas generator is somewhat similar to a gas producer except that it is equipped to blow air and steam alternately through the generator. Therefore, if a richer gas than producer gas is desired, the two stages of the process may be separated. Heated air can be blown through the coke to raise it to a high temperature, and the resulting gases burned to provide additional heat. Steam is then sent through the intensely hot coke, and the resulting water gas, with a heat value of about 300 B.t.u. per cubic foot, is collected. A complete cycle of blow and make takes about five minutes. Water gas is one source of synthesis gas, the uses of which are described elsewhere in this chapter. For use as city gas the water gas is enriched or carburetted by the addition of oil or other enricher. The oil and hot gas leaving the generator pass together through hot chequered brickwork where the oil is cracked to form permanent gases. A carburetted water gas commonly has a heat value of 500 to 600 B.t.u. per cubic foot, but this varies with the amount of oil used.

Oxygen Generated

Recent developments in connection with the use of a mixture of oxygen and steam have made possible the complete continuous conversion of coke, or coal, into a gas suitable for synthetic chemical manufacture, as described in the part of this chapter dealing with the production of synthetic liquid fuels.

Low Temperature Carbonization Processes

These processes have received very wide publicity during the past forty years and have often been proclaimed as about to revolutionize the coal industry, but up to date they have entirely failed to displace high temperature carbonization. Low temperature carbonization is carbonization at 1,100° F. or lower, in contrast with high temperature at 1,800° F. or higher. The essential characteristic of the low temperature process is that the tar is removed uncracked. The coke is weak, but is a free-burning, smokeless fuel. The tar is a good liquid fuel somewhat resembling crude petroleum, and, therefore, quite different from the coal tar used in the coal tar industry. The gas is of high heat value.

Low temperature carbonization was first advocated in England some forty years ago for a dual purpose, to reduce the serious smoke nuisance from domestic heating and to curtail the importation of petroleum. Some 800 low temperature processes were known by 1933, but up to that time only 220,000 long tons of coal per year were treated by low temperature processes in Great Britain. In 1944 in the United States the tonnages of coal carbonized by various processes were:

In by-product and beehive ovens..........	105,000,000
In gas plants..........................	1,400,000
In medium and low temperature processes...	400,000

No figures are readily available for low temperature separate from medium, but the tonnage of both was only one-third of one per cent of the total tonnage coked.

The Pittsburgh Carbonization Company uses a method known as the Disco process to produce low temperature coke in an externally heated rotary retort. The process results in small balls of dense smokeless fuel, which are particularly suitable for some types of domestic heating equipment. The low temperature tar produced, which is the only by-product, is fractionated at the plant. The residual pitch, high in carbon and ash, is charged back into the process.

The Lurgi low temperature process is in operation at Bienfait, Saskatchewan, where a non-coking lignite is treated in a low temperature carbonizer and the resulting char is briquetted and sold for domestic heating. The plant has a capacity of about 60,000 tons of briquettes a year. The raw coal is processed in massive vertical retorts by passing hot gases through the charge. The heating gases are obtained by the combustion of the distillation gases in combustion chambers connected to the retorts. The gas produced is used for processing while the tar produced is used to provide some of the binder required for briquetting. The early development work and construction of the original plant were financed by the Federal Government and the Governments of Manitoba and Saskatchewan through the Lignite Utilization Board of Canada. By 1924 this Board believed that it had demonstrated the commercial feasibility of carbonizing and briquetting Saskatchewan lignite and turned over the plant it had erected to a private company for a nominal amount. The operation was not successful, and the plant has changed hands several times. In the interval Lurgi carbonizers were installed. At present the operation is a commercial success, but at a capital cost to the present operator bearing no particular relationship to the cost of replacing the plant. Recent estimates of the cost of reproducing the plant vary from over $500,000 to over $1,000,000. Under the circumstances, it is not clear as to whether any substantial additions to the capacity of the present plant are commercially sound.

COKE AND GAS PLANTS

Twelve plants are described below as illustrating the types of plant and equipment operating in Canada at the present time. The first five of these produce mainly metallurgical coke while the others produce mainly domestic coke and/or gas. It should be understood, however, that operations in any plant

may be varied to suit the current demand for products. Plants which primarily make metallurgical coke can and do make domestic coke, and similarly, plants normally making domestic coke can and do make metallurgical coke. Plants whose principal output is gas may also have coke for sale, the amount of which varies according to the current demand for gas.

Most of the coke consumed in Canada is made in Canadian plants. Over the past decade there has, however, been an annual import of from 400,000 to 900,000 tons of coke from the United States. Most of the coke imported is used in central Canada. Exports of coke during the same period have not exceeded 50,000 tons. Exported coke comes almost entirely from the plants in the Crowsnest Pass and is used mainly by metallurgical industries in Idaho.

The Dominion Steel and Coal Corporation of Sydney, N.S., operates a by-product coke oven plant, with 180 Koppers ovens. This operation is primarily for the production of blast furnace coke for its own steel plant, but some coke is sold for domestic use. Surplus gas is used in the steel plant and the tar is sold. The coal treated would not normally be used for metallurgical coke, as it is a high volatile, gas coal which, although low in ash, is rather high in sulphur; but it is used because more suitable coal is not available. However, the steel operations of the Company are distinctly handicapped by the poor physical properties and high sulphur content of the coke. It should be understood than an inferior coke adds to the cost of production of the steel without necessarily in any way impairing its quality. The Sydney plant in 1944 treated 786,000 tons of coal.

The Steel Company of Canada at Hamilton, Ontario, operates a by-product coke oven plant, with 80 Wilputte ovens. The coal treated is all imported from the United States, and the metallurgical coke produced is normally consumed in the steel plant. In slack times, however, a crushed and sized coke is sold for domestic heating. The gas produced is nearly all used by the Company. In 1944, 649,000 tons of coal were treated.

The Algoma Steel Corporation of Sault Ste. Marie, Ontario, operates the largest by-product coke oven plant in Canada, with 103 Wilputte ovens and 141 Koppers ovens. The capacity was materially expanded during the war, with Government assistance, by the addition of 86 of the latest type of Koppers-Becker underjet ovens. The coal used, imported by water from the United States, is of varying rank suitably blended for the production of high grade metallurgical coke. Whilst the coke and gas produced are mainly made for, and consumed in, the steel plant, some coke was marketed in the Toronto area during the war, and domestic gas is supplied to the local community, through the Great Northern Gas Company. International Nickel Company and Falconbridge Nickel purchase from 200,000 to 250,000 tons of coke annually from this plant. 1,764,000 tons of coal were treated in 1944, more than two and one-half times that treated in 1937.

The International Coal & Coke Company of Coleman, Alberta, operates 104 beehive ovens, and the Crow's Nest Pass Coal Company at Michel, B.C., operates Beehive ovens and 20 Curran-Knowles ovens. Each company uses its own coal. The coke is sold mainly for metallurgical use in Canada and in adjacent markets in the United States, the largest consumer being the Consolidated Mining and Smelting Company at Trail, B.C. The specifications for coke for the non-ferrous metallurgical industries of British Columbia are less stringent as to physical strength than are those for the iron and steel industries, so that a satisfactory metallurgical coke can here be made in the Curran-Knowles ovens. In 1944 the Coleman plant treated 102,000 tons of coal and the Michel plant 127,000 tons.

The Montreal Coke and Manufacturing Company operates the largest plant making primarily domestic coke and gas, a plant surpassed in coking capacity only by the three steel companies described above. The Company

was formed in 1927 to operate a by-product coke plant with capital subscribed equally by the Montreal Light, Heat and Power Consolidated and the By-Product Coke Company of Canada, a wholly-owned subsidiary of Koppers Company of Pittsburgh. The Montreal company did not take advantage of the provisions of the Domestic Fuel Act when building their plant since they decided at the outset that it would be impossible to comply with the requirement to use 70 per cent Canadian coal and yet make a coke that could be sold in such a competitive fuel market as that of Montreal. Nevertheless, persistent efforts have been made, with technical assistance from the Dominion Fuel Board and the Bureau of Mines at Ottawa, to use the maximum percentage of Nova Scotia coal. As has been stated, up to 40 per cent could be blended with United States coals, but the Nova Scotia coal had to be of high grade, and the high price of such coal delivered in Montreal, compared with imported coals, made such blending possible only with Government aid to the coal producer. Smaller percentages have in fact been blended in recent years owing to inability to obtain larger supplies of the required grade from Nova Scotia. Equipment at the plant includes 59 Koppers ovens, and also 4 Koppers Kerpely ring-type gas producers, and a water gas plant. The coke made is largely sold for domestic heating in Montreal and the surrounding area of Quebec and Ontario, although some foundry coke is also made. The gas is distributed for domestic use by the Quebec Hydro Electric Commission. In 1944 the plant treated 565,000 tons of coal, all of it imported.

The Consumers Gas Company of Toronto, Ontario, is primarily engaged in the manufacture and distribution of coke and gas for the domestic market of Toronto. The coal used is all imported. Equipment includes 104 Glover-West vertical retorts, 220 Drakes horizontal retorts, and 8 water gas sets. In 1944 some 75 per cent of their coke was used for making gas. In 1944 some 283,000 tons of coal were treated.

The Hamilton By-Product Coke Ovens plant was built in 1924, after the Government had promised aid through tariff concessions. It replaced an earlier retort gas plant. Present equipment includes 25 Semet-Solvay ovens, 35 Wilputte ovens and water gas sets. All the coal is imported. In the year ending March 31, 1945, about 90 per cent of the coke was sold to war industries for metallurgical and similar uses, although in peacetime years about 90 per cent of the coke produced was sold for domestic use. The gas made is distributed through the United Gas and Fuel Company.

The serious wartime shortage of coke and gas in the Hamilton district was met by the erection of an additional plant comprising 54 Curran-Knowles ovens by the Department of Munitions and Supply. The plant has been operated by the Hamilton By-Products Coke Ovens. The plant cost over $4,000,000, has not operated economically, and it is anticipated that it will be scrapped when coal and coke are in long supply. In 1944 this plant carbonized 264,000 tons of imported coal.

The British Columbia Electric Power and Gas Company, Vancouver, B.C., was incorporated in 1926. In the present plant 40 continuous vertical retorts were first installed, but later 45 gas chamber coke ovens were built. These relatively small ovens, capable of producing domestic coke of good quality and large volumes of gas, were installed with a view to improving the coke structure, and, incidentally, to qualify under the Domestic Fuel Act. The equipment also includes gas producers and water gas sets. This plant used 114,000 tons of Canadian coal in 1944.

The Winnipeg Electric Company operates a by-product recovery coke oven plant primarily for the production of city gas. The gas and coke are sold locally, mainly for domestic use. The plant consists of a 17-oven battery of Koppers-Becker small gas ovens. It was constructed by Koppers, and used

imported United States coals entirely until 1933. Experiments begun in 1930 led to the substitution of coal from British Columbia and Alberta. In 1944 this plant treated 37,300 tons of Canadian coal and 34,500 tons of imported coal.

The Ottawa Gas Company, Ottawa, Ont., operates a plant for the production and distribution of carburetted water gas for domestic and other use. The present plant, put into commission in 1939, replaced an earlier plant using horizontal gas retorts. In 1944, in round figures, this plant used 3,800 tons of coke and 1,110,000 gallons of oil.

GOVERNMENT ASSISTANCE TO THE COKE AND GAS INDUSTRY

In this section we shall consider Government assistance to the coke and gas industry under the following headings:

The Domestic Fuel Act
Assistance under various Orders in Council
Tariff Assistance and The Coke Bounties Act.

Detailed statistics have not been included because they are presented in the chapter Subventions and Other Aid.

The Domestic Fuel Act

The Domestic Fuel Act was the result of recommendations made by a number of bodies. Under the auspices of the Dominion Fuel Board a study was made in 1923 and 1924 of the possibilities of domestic coke as a substitute for anthracite in central Canada. In the opinion of the Dominion Fuel Board the study indicated that conditions were favourable and the time opportune for the erection of coking plants at a number of points in central Canada and that, if plants were built at those suitable points, it would be possible to produce enough coke to displace up to 35 per cent of our importations of American anthracite. The 1926 House of Commons Special Committee Investigating Coal Resources of Canada agreed with the Dominion Fuel Board and recommended that such legislation be enacted as would encourage the production of domestic coke. At about the same time two Royal Commissions recommended Federal Government action to encourage the production in Canada of domestic coke from Canadian coals. The first of these was a Nova Scotia Commission on the coal mines of that Province, the second was the Federal Royal Commission on Maritime Claims; both were under the chairmanship of Sir Andrew Rae Duncan. The second Commission declared that "there can be no doubt that the establishment of coking plants under the assistance of the Dominion Government, for the coking of Canadian coal, would go far towards solving the coal problem in the Maritime Provinces."

The Domestic Fuel Act of 1927 was, therefore, designed for the two-fold purpose of assisting the Canadian coal mining industry and at the same time relieving the domestic fuel situation. Under the Act an annual subsidy payment of 4 per cent (or in some cases 5 per cent) of the capital cost of a coking plant would be paid by the Government, provided that at least 70 per cent of the coal used was of Canadian origin and that the amount did not exceed one dollar per ton of Canadian coal used in the production of coke sold for domestic use. If less than 70 per cent, but more than 50 per cent, of the coal thus used was Canadian, smaller amounts would be paid.

Three coking plants have been built or re-built under the Act. They are the plants of the Nova Scotia Light & Power Company at Halifax, the Quebec Power Company of Quebec, and the British Columbia Electric Power & Gas Company at Vancouver. These plants are still in operation. Up to March 31, 1946, subsidy payments to them under this Act totalled $737,608, covering the use of 748,981 tons of Canadian coal of which 139,450 tons was used at Halifax, 187,196 tons at Quebec, and 422,335 tons at Vancouver.

It is now abundantly clear that the high hopes of those who advocated the Domestic Fuel Act have not been realized. This was frankly admitted by the 1932 Nova Scotia Commission on the coal mines of that province, again under the chairmanship of Sir Andrew Rae Duncan. The largest domestic coke and gas plant in central Canada, that of the Montreal Coke and Manufacturing Company, was built after the Act came into effect, but did not apply for aid under it because the operators did not believe that they could use even 50 per cent Canadian coal. The construction of the two plants at Halifax and Quebec has provided neither a large market for Canadian coal nor a large source of domestic coke, and thus the Act has contributed little to solving the coal problem in the Maritime Provinces or to improving the domestic fuel situation in central Canada. The largest payment under the Act has been that to the Vancouver plant. This assistance has undoubtedly increased the market for Vancouver Island coal, but, inasmuch as no anthracite was used in British Columbia previously, it has not affected in any way our reliance on United States sources of anthracite.

Assistance Under Various Orders in Council

The failure of the Domestic Fuel Act and the experience of the coke plant at Montreal indicated that if a stimulus was to be given to domestic coke manufacture in central Canada, it would have to be done in such a way that plants using Canadian coal, but in amounts less than 50 per cent, could benefit. Therefore, Order in Council P.C. 944, of 1932, provided assistance on Canadian coal so used up to the difference in the laid-down cost at the coke plant between Canadian and imported coal with a maximum of one dollar per ton. This Order in Council was designed particularly to encourage the use of Nova Scotia coal in the Montreal coke plant and it was successful in providing a pre-war movement of about 170,000 tons of Nova Scotia coal per year to that plant at a cost to the Government of just under one dollar per ton. Under the same Order in Council there have been small movements of coal to the plants of the Ottawa Gas Company and Shawinigan Chemicals. Under other but similar Orders in Council there were small movements of Nova Scotia coal to the plant of the Hamilton By-Product Coke Ovens Limited during 1936 and 1937. In the thirteen years up to the end of 1945, about 1,700,000 tons of Nova Scotia coal have moved under Order in Council assistance to coke plants. Since the assistance has been given on the principle of equalizing laid-down costs, the assistance is of benefit to the coal industry rather than to the coke plants.

Under P.C. 944 and various other Orders in Council more than 700,000 tons of western Canadian coal have moved into the Winnipeg Electric Company's coke ovens. The tonnage moved has fluctuated considerably from year to year, but has on occasion been important, particularly in that much of it has been slack coal. As in central Canada, assistance given to this movement benefited mine operators rather than the coke plant.

Tariff Assistance and The Coke Bounties Act

Since 1907 there has been a measure of assistance given to the coke and gas industry in Canada through the remission of a portion of the duty paid on coal imported for use in coke and gas plants when the coke made is used for certain specified purposes. The details of these arrangements may be found in the chapter Subventions and Other Aid. The most interesting of these provisions is that in effect since 1934, allowing a withdrawal of 99 per cent of the duty paid on imported coal where the coke made is sold for use as a fuel in other than a coke or gas plant, provided that not less than 35 per cent of the bituminous coal used was mined in Canada. The effect of this provision has been that a plant such as that of the Montreal Coke and Manufacturing Company Limited,

when using at least 35 per cent Canadian coal, can import foreign coal almost duty free. In the case of that plant, this provision has provided the incentive to take advantage of P.C. 944.

The 1926 Federal Royal Commission on Maritime Claims suggested that the 99 per cent drawback allowed on imported coal, when the coke produced from it is used for metallurgical purposes, amounted to a subsidy and that a similar subsidy should be paid on Canadian coal used in the steel industry. This recommendation was given effect by the Coke Bounties Act of 1930. Under this Act a bounty of 49.5 cents per ton is paid on bituminous coal mined in Canada and used to produce coke for the steel industry. In the fiscal years 1930 to 1945 inclusive, $3,913,000 in bounties has been paid on approximately 7,900,000 tons of coal, all of it mined in Nova Scotia.

GENERAL CONSIDERATIONS AFFECTING THE COKE AND GAS INDUSTRY AND ITS FUTURE

The future of that section of the coke and gas industry which produces principally for the steel industry will, of course, depend largely on the future of the steel industry. In metal smelting coke acts at the same time as both a fuel and a chemical reducing agent and no adequate substitute for it in this dual role is available. For the subsequent working of metal, whereas coke is widely used, it is meeting increasing competition from other fuels and from hydro-electric power. Generally speaking, however, the coke requirements of the metal industries will depend upon the level of activity in those industries.

One of the outstanding features of modern by-product coke ovens is their flexibility. Ovens which normally produce good metallurgical coke can also supply good domestic coke. When the requirements of the steel industry fall off, the makers of metallurgical coke usually prefer to turn to domestic coke rather than to close down, and their offerings consequently increase competition in the market for domestic coke. This circumstance is a considerable deterrent to the development of plants built primarily to supply domestic coke, for the operators must face the prospect of periodic invasions of such market as they may develop by surplus coke from metallurgical plants.

Coke has many advantages as a domestic fuel. The experience of those who have been engaged in developing the domestic market for coke indicates clearly, however, that if it is to compete successfully in the domestic fuel market, the coke offered must be of high quality. This fact has led coke manufacturers to lay greater and greater emphasis on obtaining the most suitable coals. The exact specifications for coal to be used for domestic coke have made it increasingly difficult to supply coal from Nova Scotia mines. There is no evidence that these specifications can be relaxed, for the domestic fuel market promises to continue to be highly competitive. Anthracite will continue to be available and the pressure from oil promises to increase. In the domestic market there is a distinct trend towards automatic equipment which will probably militate against the use of coke, for coke is unsuitable for such equipment. Bituminous Coal Research in the United States is endeavouring to develop domestic heating equipment in which high volatile coal may be burned without smoke. Should its efforts be successful, bituminous coal may become much more strongly competitive in the domestic market to the disadvantage of coke and other domestic fuels.

The successful commercial operation of a by-product coke plant depends equally as much on an adequate market for gas as it does on an adequate market for domestic coke. The capital cost of a gas distribution system is necessarily high and, therefore, manufactured gas can only be distributed in large urban areas. Gas manufactured from coal is limited in its ability to compete with

other fuels for space heating because of the seasonal character of the load. It is therefore used most successfully where the seasonal factor is insignificant such as for cooking, water heating and specific industrial purposes. Within that market gas is under strong competition from electricity, for in many areas in Canada hydro-electric power is relatively cheap. In the areas where natural gas is available, gas from coal is not competitive.

The use in recent years of liquefied petroleum gas is a further instance of competition with gas derived from coal. The petroleum and natural gas industries have to deal with considerable amounts of hydrocarbons which are gaseous under ordinary conditions of temperature and pressure, but which may be liquefied under comparatively low pressures, and can, therefore, be distributed in suitable tank cars and light cylinders. Liquefied petroleum gas is particularly suitable for supplying the intermittent heat requirements of urban and rural and small urban communities. The gas, which has a very high heat value, is also used to supplement supplies of natural or other manufactured gas. This gas, however, is relatively costly.

CONVERSION OF COAL TO SYNTHETIC LIQUID FUELS

Much popular interest has been aroused in the synthetic production of petroleum from coal. Prior to the war, it was commonly known that there was a sizable and expanding industry in Germany and that one full-scale plant had also been built in England. Two synthetic processes were used, both having been originally developed through technical research in Germany. These are commonly known by the names of their respective inventors, high pressure hydrogenation having been invented by Bergius and hydrocarbon synthesis by Fischer and Tropsch. The first process is applicable to coal or to such heavy liquids as tar and natural bitumen, while the Fischer-Tropsch synthesis can start either with coal or with natural gas.

With the exception of some small plants in Japan and France, the bulk of synthetic petroleum, prior to and during World War II, was produced in Germany and England; there were only small-scale research plants in the United States. When Germany was invaded in 1945, the synthetic oil industry was one of the first to be investigated. It was found that the major part of the synthetic oil was produced by the high pressure hydrogenation process. The total capacity of both processes was of the order of 40,000,000 barrels per year. The total production in Germany from all sources, including both natural and synthetic production, was about 56,000,000 barrels per year. The Government of Great Britain, following the advent of Hitler's leadership in Germany, established one high-pressure hydrogenation plant at Billingham, capable of producing 3,500 barrels of high octane gasoline daily, not a large production when measured with the total needs of modern war, and yet large enough to make a significant contribution to the supply of aviation fuel. The oil-from-coal industry can, therefore, be said to have reached major proportions in Germany and to have been established on a full scale in England. It should be emphasized, however, that none of this production was economically competitive with natural petroleum.

The major research effort in the United States at present is being made by the Bureau of Mines which was authorized by Congress to make expenditures over a period of five years up to the amount of $30,000,000. The program is already well under way and is divided into several branches. The main research laboratory is to be located at Bruceton, Pa., near Pittsburgh, where experimental equipment for the study of both high pressure hydrogenation and the Fischer-Tropsch type of synthesis, on a small scale, will be undertaken. Demonstration plants for large scale work, again following both of the fundamental methods, are being established at Louisiana, Mo. An experimental plant at

Rifle, Col., is to study methods for the recovery of shale oil. Other experimental work is being carried out on production of water gas from coal at Morgantown, W.Va. The oil companies in the United States are interested in a modification of the Fischer-Tropsch method with a view to converting natural gas to gasoline. Quite apart from the experiments being conducted by the United States Bureau of Mines, some of the commercial companies have already made considerable experimental progress along this line. The foregoing information with respect to research in the United States is set out in some detail, partly to illustrate the present status of the industry and also to emphasize that, notwithstanding the large coal resources of that country, no attempt has yet been made to proceed with commercial scale production as has been done in Germany and Great Britain.

It has been suggested that further research be undertaken in Canada in the field of synthetic liquid fuels. Small-scale experiments have been conducted by the Division of Fuels of the Bureau of Mines. The field is a large one and much research is currently being undertaken in the United States. Accordingly, it is desirable that any activities in Canada in this direction should be intensive and complementary to the work being done there, since it is assumed that these two countries can co-operate in the future as they have done in the past.

Interest in the subject has in part been due to the fact that most of the petroleum consumed in Canada is imported. The value of imported petroleum is more than $100,000,000 per year. Taking a broader view, the petroleum supply of the world as a whole is not inexhaustible and, when the rate of production cannot be maintained at as high a level as the rate of consumption, the price of petroleum will rise to a point where substitutes will be able to compete economically. Another factor contributing to interest in the possibility of producing oil from coal has been the desire for security in wartime when the supply of petroleum from foreign sources may be interrupted. The coal mining industry is especially concerned because it would be profoundly affected by any major substitution of coal for petroleum as the source of material for liquid fuels. Assuming that 0.6 tons of coal can be converted to the equivalent of one barrel of petroleum, the following table indicates the amount of coal that would be required to replace various proportions of the total petroleum consumption of Canada:

Percent Replaced by Coal	Coal Requirements (millions of tons)
100	34.0
50	17.0
10	3.4

These figures are, of course, arbitrary and approximate and apply to bituminous coal. If low rank coals were used, the requirement would be greatly increased.

A technical treatment of the subject follows.

METHODS

The methods that must be employed in order to convert coal to liquid hydrocarbons are indicated in a general way by comparing the chemical composition of the raw material with that of the product. The hydrogen content of coal is about 6 per cent and that of gasoline about 14 per cent; there are substantial quantities of oxygen, nitrogen and sulphur in coal and practically none in gasoline; and coal has a very high and indefinite molecular weight and gasoline a much smaller average molecular weight. To convert coal into gasoline three changes must be made, hydrogen must be added, oxygen, sulphur and nitrogen removed, and the large molecules broken down into smaller ones. The hydrogen required for the conversion is usually made from coke and steam by a process absorbing thermal energy, which is also produced from coal, so that, considering the overall conversion and neglecting minor products, coal and water go into a series of reactions and gasoline and carbon dioxide are produced.

Although the overall conversion is defined by the chemical compositions of the materials involved, two fundamentally different methods have been devised for carrying it out. One of these, called hydrogenation, brings about the chemical combination of hydrogen with coal through the agencies of high pressure and catalysis. The other, called indirect hydrogenation, or more commonly, the Fischer-Tropsch synthesis, converts the coal to water gas, adds hydrogen and converts the mixture of gases to hydrocarbons by passing it over a catalyst.

Direct Hydrogenation (*Bergius*)

It is difficult to give a concise description of the process of coal hydrogenation because of its complexity. The outline of the process that follows will, therefore, be confined as far as possible to fundamentals.

The conversion of coal to gasoline is accomplished in a series of separate stages. In the first stage, the coal is liquefied and yields as its principal net product a distillable middle oil. In the second stage, the middle oil is purified from compounds of nitrogen which would poison a catalyst that is used subsequently. In the third stage, the purified middle oil is converted to gasoline. All three stages have two conditions in common; first, a stream of hydrogen flowing through the reaction zone at a pressure of several thousand pounds per square inch, and second, the presence in the reaction zone of catalytic materials.

The manufacture of hydrogen can be considered as the starting point of the process. Of the numerous methods that have been developed for the production of hydrogen, the one most commonly used in Germany and in England is well known and has been employed for many years in the synthetic ammonia industry. In it hot coke is blown alternately with air and steam to produce water gas. The water gas is then passed over a catalyst with additional steam which converts most of the carbon monoxide to hydrogen and carbon dioxide. The chemical equations for these processes are as follows:

1. $C + H_2O = CO + H_2$
2. $CO + H_2 + H_2O = 2H_2 + CO_2$

The mixture of gases resulting from these reactions is compressed and the carbon dioxide and the carbon monoxide removed from it by selective solvents. The purified hydrogen is introduced into the re-circulating streams of hydrogen that flow through the reaction zones. About 250 to 300 cubic feet of hydrogen are required for the production of one gallon of gasoline from coal.

In preparation for the first stage of hydrogenation, the coal is dried and, if necessary, cleaned. Approximately half of the total coal is put through the liquefaction process, the remainder being required for fuel, hydrogen production, etc. Because of this division of the raw material, the high grade portion can be processed and the low grade portion used as fuel. The portion to be hydrogenated is pulverized and mixed with a heavy recycle oil and with a small amount of a compound of iron or tin as a catalytic material. The proportion of coal to recycle oil is usually about 45:55. When tin is used as the catalyst, its activity is increased by the presence of hydrochloric acid and the comparatively low pressure of about 4,500 pounds per square inch can be employed. When iron is used as the catalyst, the acid is not necessary but the pressure should be about 10,000 pounds per square inch. In the newer German plants, the trend has been towards the use of iron catalysts and higher pressures.

The paste of coal, oil and catalyst is injected into the high pressure system where it joins the stream of circulating hydrogen. The mixture of paste and hydrogen is passed through a heating system and into the reaction chambers where the temperature is about 900° F. There are usually four of these in series and a unit of four chambers, together with the heater and other auxiliary equipment, is

called a "stall". The volume of reaction space in a stall is about 950 cubic feet and about 13 tons of coal are liquefied per hour in each stall. The product from the reaction chambers is collected, cooled and let down to atmospheric pressure. It is distilled and otherwise processed to yield a heavy oil which is mixed with fresh coal and recycled through the first stage. The other product is a light oil boiling between 32° and 600° F., which is passed on to be processed in the second stage.

The purpose of the second stage of hydrogenation is to remove nitrogen compounds from the light fraction produced in the first stage. If these are not removed, they react with the catalyst that is used in the third stage and greatly reduce the length of time that it is effective. The equipment employed in the second stage is similar to that of the first stage and the pressure is usually of the order of 4,500 lbs. per square inch but the temperature is lower, about 750° F., and the catalyst is tungsten sulphide. The catalyst is not finely powdered and mixed with the feed stock as in the first stage but is in the form of pellets that remain in fixed position in the reaction chamber. The throughput of middle oil is about 19 tons per stall per hour. Fewer stalls are required in any given plant for the second than for the first stage; for instance, at Leuna there were 10 first stage, 5 second-stage and 3 third-stage stalls.

The function of the third stage is to convert the purified oil from the second stage into gasoline. The equipment, pressure and temperature employed in the third stage are similar to those of the second but the catalyst most commonly used consists of tungsten sulphide mixed with an activated clay. This catalyst produces gasoline of a fairly high octane number. The rate of throughput of feed stock is about 22 tons per stall per hour. About 40 per cent of the product has a boiling range above that of gasoline and this fraction is mixed with fresh feed stock and recycled through the third stage when the net liquid product is to be entirely gasoline.

In addition to the three-stage process as outlined above there are, in some plants, dehydrogenation, polymerization, and alkylation units similar to those employed by the petroleum industry. The purpose of these is to prepare base and blending stocks of especially high octane number for the manufacture of aviation gasoline.

Regarding the nature of the coals that are suitable for direct hydrogenation, it has been established by extensive experimentation that, in general, coals of a rank below medium volatile bituminous are readily liquefiable. Above that rank too large a proportion remains unliquefied for successful technical operation. There is no lower limit to the rank that can be liquefied as is evidenced by the extensive use in Germany of different types of brown coal. Within a given rank there is some variation in amenability to liquefaction depending on the proportions of the various petrographic constituents. The dependence of yield on petrographic composition has been intensively studied by the United States Bureau of Mines and, where petrographic analyses are available, yields can be predicted with sufficient precision to eliminate some coals that might otherwise be subjected to pilot plant assays. Thirdly, the ash and moisture contents of the coals are factors to be taken into consideration. A coal high in ash not only contains less liquefiable matter but also the ash has to be removed from the heavy recycle oil in order to prevent accumulation and this involves a loss of oil roughly equal to the weight of the ash.

Only a relatively small proportion of all Canadian coals are of too high rank to be considered for hydrogenation. In order to choose the most suitable coal for this purpose a preliminary selection would, therefore, be made on the basis of grade and cost. Since few petrographic analyses have been made for Canadian coals, it would be necessary to make extensive laboratory tests and, after narrowing the field on a basis of their results, to conduct pilot plant tests.

The following table taken from the Bureau of Mines Publication No. 798 summarizes the results of laboratory tests on a series of Canadian coals. The yields indicated do not, of course, include the coal that would be required for fuel, etc., in a commercial-scale plant.

—	—	Imp. Gals. of primary oil per 2000 lbs. dry and ash-free basis
Crowsnest	Medium-volatile bituminous	124
Vancouver Island	High-volatile bituminous A	134
Sydney	High-volatile bituminous A	154
Saunders	High-volatile bituminous C	107
Drumheller	Sub-bituminous B	125
Edmonton	Sub-bituminous C	115
Bienfait	Lignite	113

The main product of coal hydrogenation in any of the existing commercial plants is gasoline. In both Germany and Great Britain, the gasoline was largely finished to aviation specifications. The finished gasoline is very similar to that produced for the same purpose from petroleum and, in fact, it was only with considerable difficulty that the origin of gasoline in captured enemy equipment could be determined. In Germany, motor gasoline, diesel oil and fuel oil were also made from coal by direct hydrogenation. Lubricants were prepared by secondary processing of oils from hydrogenation. Contrary to the general impression, Germany was not handicapped by the quality of the petroleum substitutes produced from coal.

In this report, unless otherwise stated, the yields are based on the total coal requirement, including fuel. The variation of yield with changing rank is especially pronounced if the amount of coal used is expressed on the as-mined basis including water. Less important variations are due to differences in methods of processing and in the nature and quality of the products obtained. In order to specify the yield with precision it is, therefore, necessary to fix all of these variable conditions. As an approximation to be used in rough estimating, it can be assumed that the overall yield is about one barrel of gasoline from 0.6 tons of bituminous coal, or from 1.8 tons of lignite containing 50 per cent moisture. In order to make an accurate estimate for any given coal and processing procedure, it is necessary to determine certain factors by actual test in a pilot plant.

HYDROGENATION COSTS*

LEUNA WORKS

—	†RM/Hour	Cents/Gal.	Per Cent of Total
A. *Materials*—			
1. Raw Materials: Brown Coal	972.00	1.8265	7.065
Brown Coal Tar	1,248.00	2.3452	9.072
2. Other Materials—			
Make-up Gas (96 per cent H_2)	6,753.60	12.6911	49.094
Red Earth (dried)	306.00	.5750	2.224
Catalyst and other chemicals	144.80	.2721	1.053
3. By-Products (Credits)—			
Butane	*910.25*	*1.7105*	*6.617*
Propane	*1,131.43*	*2.1261*	*8.224*
Ethane	*315.70*	*.5933*	*2.295*
Hydrogenation Gas	*1,386.00*	*2.6045*	*10.075*

*Capital costs are included in each item.
† Reichsmarks.

HYDROGENATION COSTS*—*Concluded*

LEUNA WORKS—*Concluded*

—	†RM/Hour	Cents/Gal.	Per Cent of Total
B. *Running Costs*—			
Coal, steam drying of	185.90	.3493	1.351
Coal, gas-fired drying of	747.85	1.4053	5.436
Paste preparation	467.67	.8788	3.399
Paste injection	207.79	.3905	1.511
Coal stalls	931.76	1.7509	6.773
Heavy oil let down centrifuges	125.25	.2345	.910
Heavy oil let down kilns	801.51	1.5061	5.826
Tar centrifuges	113.70	.2137	.827
Liquid phase distillation	288.10	.7293	2.821
Gas washing plant	173.57	.3262	1.262
Circulation	274.66	.5161	1.996
Vapour phase injection	128.11	.2407	.931
Vapour phase stalls	613.61	1.1531	4.461
Vapour phase distillation	283.49	.5327	2.061
Petrol wash	26.14	.0491	.190
Depropanizing plant	67.40	.1267	.490
Liquid phase, rich gas purification	286.22	.5379	2.081
Liquid phase, rich gas fractionation	524.18	.9850	3.810
Petrol testing	6.26	.0118	.046
Liquid phase intermediate storage	152.23	.2861	1.107
Vapour phase intermediate storage	41.43	.0779	.301
Hydrogenation, drain water treatment	60.96	.1145	.443
Hydrogenation, phenol separation	9.02	.0169	.065
Hydrogenation, phenol washing	20.61	.0387	.150
C. *Loading and Evaporation*	217.20	.4082	1.579
D. *Additional Costs* (I. G. direction, research, etc.)	1,220.66	2.2938	8.873
Total	13,756.31	25.9	100.0

*Capital costs are included in each item.
†Reichsmarks.

Although there are numerous statements in the technical literature regarding the cost of hydrogenation of coal, there are only two organizations that have outstanding technical knowledge of the subject; source material for most of the statements has originated with the I. G. Farbenindustrie in Germany or Imperial Chemical Industries in England. As in the case of yields, the costs vary widely depending on the particular raw material, product and process modification selected. The most recent and detailed cost that has been published was obtained by a team of technical investigators at the Leuna plant of the I. G. Farbenindustrie. This team was sponsored by the British Ministry of Fuel and Power, the United States Petroleum Administration for War, and the United States Bureau of Mines. These costs are summarized in the table concluded above. Although these figures apply to brown coal, other more approximate figures based on bituminous coal are of the same order of magnitude. It will be noted that, taking the reichsmark at its nominal value of 40 cents, the cost of motor gasoline is about 26 cents per gallon. It will be well to bear in mind in converting German to Canadian costs that the relative value of the reichsmark is uncertain.

The capital cost for coal hydrogenation plants also varies considerably depending on the exact conditions for which the plant was designed and it is safe to say that there is no plant in existence which would exactly fit conditions in Western Canada. The capital costs for the Leuna plant were not given in the reference that has been quoted but a rough approximation has been given in the report of the Falmouth Committee published in 1938. This applied to English conditions at that time and, of course, does not take into consideration improvements that were developed in Germany during the war. The cost of a

plant to produce 150,000 long tons per year of motor gasoline was given as £8,000,000 (approximately $40,000,000) which is equivalent to about $11,400 per barrel per day of gasoline producing capacity. A rough value for estimating can, therefore, be taken as $10,000 per barrel per day but any such estimate must be used with the understanding that it indicates only the order of magnitude of the cost.

Fischer-Tropsch Process

In this report a distinction is made between the Fischer-Tropsch process as established in Germany and the developments along the line of hydrocarbon synthesis that are now in progress in the United States. These are both based on catalytic synthesis of hydrocarbons from carbon monoxide and both are commonly referred to as the Fischer-Tropsch synthesis. In some respects, however, they are fundamentally different and there would be less confusion if the newer developments were distinguished by a different name. In this report the name Fischer-Tropsch is applied exclusively to the process that was established in Germany. The newer work that is now in the development stages in the United States is referred to as the Improved Fischer-Tropsch Synthesis.

Unlike the hydrogenation process, there is relatively little variation in the design of the Fischer-Tropsch plants. There were nine of these in Germany and one in France, all of which followed closely two basic designs. These designs were developed by the Ruhrchemie A.G. The plants were built between 1933 and 1939 and were operated without any major addition or alteration until they were put out of operation by bombing in 1944-45.

The general chemistry of the process can be reduced to simple equations. First, water gas is produced from coke according to the equation: $C + H_2O = CO + H_2$. Secondly, the ratio of hydrogen to carbon monoxide is increased to 2:1. This is usually done by separating one-third of the water gas, converting the carbon monoxide in it to hydrogen according to the equation: $CO + H_2 + H_2O = CO_2 + 2H_2$ and adding the hydrogen to the remaining two-thirds of the original water gas. The carbon dioxide is removed by solution in a selective solvent. This part of the process is similar to the preparation of hydrogen for the hydrogenation process. The amount of hydrogen that has to be made separately is also of the same order of magnitude, about 300 cubic feet per gallon of primary hydrocarbons produced. The total requirement of synthesis gas, including the separately-prepared hydrogen, is about 1,000 cubic feet per gallon of primary hydrocarbons. Finally, the synthesis gas, consisting principally of hydrogen and carbon monoxide in the ratio of 2:1, is passed over a catalyst and is converted to hydrocarbons according to the equation $CO + 2H_2 = -CH_2- + H_2O$. The molecular unit $-CH_2-$ shown in this equation readily combines with others to form various hydrocarbons.

As in hydrogenation, the production of water gas is the first step. This is ordinarily carried out by the conventional reaction between steam and coke that has already been described. Although there are numerous other means of producing water gas, the Humphreys-Glasgow process was the one favoured in Germany. The crude water gas contains considerable amounts of sulphur both as hydrogen sulphide and as organic sulphur compounds. This would poison the sensitive catalyst that is used in the synthesis stage and it has to be removed almost completely. The hydrogen sulphide is taken out first by passing the gas over iron oxide at ordinary temperature. The organic sulphur is then taken out by further treating the gas with a mixture of iron oxide and soda at a temperature of about 400° F. After the sulphur has been removed, the ratio of hydrogen to carbon monoxide is adjusted by reacting one-third of the gas with steam over an iron-containing catalyst. The gas after this stage is called synthesis gas and it is either sent directly to the reaction chambers or is compressed to about 150 pounds per square inch, and then passed to the reaction chambers.

The synthesis reaction takes place on the surface of a catalyst at 360° to 400° F., and the temperature must be closely controlled to avoid rapid deterioration of the catalyst and undesired side reactions. Control of temperature is difficult because of the large amount of heat that is liberated by the reaction. It was found that, with a granulated catalyst in a fixed position, no part of the catalyst should be farther than about one-quarter of an inch from a heat-absorbing surface. This condition defined the fundamental nature of the reaction chambers. One design, used when the reaction is carried out at atmospheric pressure, consists of steel plates placed 0.29 of an inch apart with the catalyst between them. The plates were cooled by water pipes in contact with them as well as with the catalyst. A reaction chamber consists of 555 vertical plates and 630 horizontal water pipes and weighs, when empty, about 46 tons. The other design, employed for the medium pressure synthesis, uses banks of double concentric tubes with the catalyst placed between them and with water both inside the inner tube and outside the outer tube. About 2,000 double tubes comprise one chamber which weighs about 49 tons. The steam generated by the heat of reaction amounts to about 5 pounds per pound of hydrocarbon oils produced and is used in the plant for the manufacture of water gas, power, etc.

The catalyst used in all the German plants was composed of cobalt, thoria, magnesia and keiselguhr in the proportions of 30:1.5:2.5:66. The same catalyst was used for both low and medium pressure synthesis. It was made only by the Ruhrchemie in a separate part of their main plant at Holten and was shipped out in special rail cars to the various plants. Spent catalyst from the other plants was returned to Holten for reconversion into fresh catalyst. A charge of catalyst weighs about three tons, occupies about 350 cubic feet and lasts for three to four months. Synthesis gas is passed over the catalyst at a rate of about 100 cubic feet per cubic foot of catalyst per hour. At this rate each reaction chamber produces approximately one barrel of primary hydrocarbons per hour.

Contact with the catalyst converts a large part of the synthesis gas into hydrocarbons which range in molecular size all the way from methane to hard paraffin wax. Some of the wax remains on the catalyst and is periodically dissolved off; the heavier oils condense when the gases, leaving the chamber, are cooled and the lighter oils are absorbed from the residual gases by activated charcoal. Usually the residual gases are subjected to a second pass through another stage of chambers, absorbers, etc. The residual gas leaving the second stage is used for fuel. The raw products are refined first by distillation, which yields motor fuel and diesel oil, and secondly, by various chemical processes for the preparation of marketable waxes, lubricants, edible fats, etc.

The raw materials that can be used for the Fischer-Tropsch synthesis are theoretically any which can produce water gas. This, of course, is a very wide range, and in theory includes all carbonaceous materials. On the other hand, in Germany the range of coals that were considered suitable was narrow. With the exception of two of the plants, all used high temperature coke prepared from bituminous coal and there is some doubt concerning the successful operation of the two exceptional plants using the other raw materials. There is a possibility that materials with a high proportion of volatile matter, when gasified, produce a gas containing entrained minute drops of tar which deposit on the iron oxide mass that is used for sulphur removal and inhibit its activity. This permits sulphur to pass through to the synthesis catalyst, poisoning it. It is not certain whether the preference in Germany for high temperature coke as a raw material was due to this or some other technical reason or whether it was purely a matter of economics. In our present state of knowledge, however, if a Fischer-Tropsch plant were to be established in this country to convert coal to hydrocarbons, some risk would be involved in using any other material than high temperature coke. Active development work is now in progress directed

towards invention of new and relatively cheap methods for production of water gas from a wide range of coals including lignites, sub-bituminous and bituminous coals. Should this work indicate the possibility of producing a satisfactory synthesis gas for the Fischer-Tropsch process, the conclusion given above, which was based on German practice, would have to be entirely changed.

The nature of the products produced by the Fischer-Tropsch process is not in any way affected by the original raw material. The products are almost entirely hydrocarbons belonging to the paraffin and olefin series. The hydrocarbons are principally of the straight chain type and, for this reason, the gasoline product has a very low octane number. As previously stated, the molecular size of the products varies widely from methane to the very large molecules that comprise paraffin wax. At the Holten plant of Ruhrchemie, the distribution of products according to boiling range from both atmospheric and medium pressure operation is shown in the following table:

—	Product	Per Cent by Weight	
		Atmospheric Pressure	Medium Pressure
Propane, butane	Treibgas	13	9
Boiling range 35—160° C	Light naphtha	45	36
Boiling range 160—230° C	Diesel oil	18	16
Boiling range 230—320° C	Gas oil	16	18
Boiling range 320—400° C	Soft wax	5	12
Boiling range 400—460° C	Table paraffin	1	2
Boiling range above 460° C	Hard wax	2	7

Referring to the table, the propane, butane fraction called treibgas by the Germans was used as a motor fuel. It was carried in cylinders under pressure on the tops of motor vehicles. The light naphtha fraction was used as a constituent of motor gasoline although its octane number was only about 50. The diesel oil is of good quality especially as regards its cetane number, which is above 100. The higher boiling fractions were for the most part not used as fuels but were converted by further processing into lubricants, hard and soft waxes, alcohols which were used in the manufacture of detergents, edible fats, etc. The trend in Germany appeared to be towards the use of medium pressure synthesis and other conditions which would increase the fraction of higher boiling constituents. It was thought that the best use for the Fischer-Tropsch process lay in the production of chemical raw materials rather than in the production of fuels.

The yields that are obtainable by the Fischer-Tropsch process are indicated by a theoretical study of the chemistry involved. Considering the equation $CO + 2H_2 = -CH_2- + H_2O$ it can be shown that 1,077 cubic feet of completely pure synthesis gas can yield at most 14 pounds of hydrocarbons which, converted to other units, shows that 539 cubic feet can produce about one Imperial gallon of primary products. However, this first approximation does not take into consideration the formation of methane and ethane and, in practice, it is usually found that 750 cubic feet of ideal synthesis gas are required per Imperial gallon of hydrocarbon products. Further, in actual practice synthesis gas is not entirely pure but contains carbon dioxide, nitrogen and other impurities and, after it has passed two stages of synthesis, the concentration of impurities is increased so that a considerable proportion must be discarded. Taking as an example an actual flow sheet, that of the Krupp Treibstoffe Werke, 60,000 cubic metres of water gas produce 7.33 metric tons of total product including propane and butane or 6.66 metric tons of liquid and solid products. This works out to 955 cubic feet of water gas per Imperial gallon of total primary product including wax and propane and butane, or considerably more than

1,000 cubic feet if only liquid products are considered. In normal practice with the standardized type of water gas generator, one ton of coke produces about 60,000 cubic feet of water gas, and, assuming that a ton of coke is produced from 1.5 tons of coal, the overall yield of primary products from one ton of coal is 40 gallons or, put in another way, one barrel of primary products is produced from 0.875 tons of coal. If the major product is to be gasoline, a further reduction in yield is introduced by the losses from cracking of the high boiling fractions of the primary product. These losses, according to Denig, reduce the volume of gasoline to 80 per cent of the volume of the primary product so that one barrel of gasoline would be produced from about 1.1 tons of bituminous coal. From this quantity of coal there are, in addition to the synthetic products, the by-products, tar and gas, that are produced in the gasification step.

Numerous estimates of the cost of the Fischer-Tropsch process were made before the end of the war on the basis of partial information that had been given out by the Ruhrchemie prior to 1939. Among these were the report of Sir David Rivett to the Australian Government, the submission of R. P. Russell to the United States Senate Committee on Bill 1243 in 1943, the submission of Mr. Fred Denig of the Koppers Company to the same Committee and the report of the Falmouth Committee in Britain in 1938. The more recent data obtained by interrogation of Dr. Friedrich Martin, President of the Ruhrchemie, since the war, has indicated that prices for gasoline as given in these previous reports were somewhat too low as was also the capital cost of the plants. The cost of the primary products was given by Martin as 300 reichsmarks per metric ton which, taking the reichsmark at its nominal value of 40 cents, would give a cost of 40 cents per gallon of primary product and a considerably higher cost if the heavier fractions were processed to gasoline. Martin also stated that the capital investment cost for Fischer-Tropsch plants was generally figured at 800 reichsmarks per metric ton of annual production capacity of primary products exclusive of land and utilities. Reducing this to the same basis that was used for the hydrogenation costs given previously in this report, the cost works out to $13,600 per barrel of daily capacity to which must be added the cost of land and utilities. It will be seen that both the capital cost and the cost per unit of hydrocarbon product are considerably higher than was the case for high pressure hydrogenation, which fact is consistent with the German policy for development of synthetic fuels which extended the hydrogenation industry during the war but did not extend the Fischer-Tropsch industry.

Improved Fischer-Tropsch Synthesis

From the foregoing section on the European Fischer-Tropsch process, it is apparent that this process has three major faults, namely, the high cost of producing water gas by conventional methods; the large and expensive heat transfer equipment that is necessary; and the nature of the products, most of which require extensive processing in order to be marketable. Beginning before the war, a group of United States oil interests energetically attacked the problem of eliminating these faults. At present their efforts are primarily directed towards a process to be applied to natural gas but, as a long term project, they are also considering coal as a source material. The United States Bureau of Mines is also working on the same problem, especially as regards production of cheap synthesis gas from coal. No full scale synthesis plant is yet in operation but pilot plants on a scale of 10 to 20 barrels per day have been built and, based on the operation of these, some cost estimates have been worked out.

As a means of correcting the first fault, the high cost of synthesis gas, it is proposed to employ fluidized gasification. In this method a bed of pulverized coal is blown with oxygen and steam to produce a synthesis gas. The pulverized fuel is violently agitated by the gaseous streams flowing through it and has many of the properties of a true fluid, hence the name. Because the coal has uniform temperature distribution and can be easily transported in the fluidized state,

the process can be operated continuously in a steady state condition. The economic advantage of this method is expected to be that it can use coal rather than coke as a raw material and that it can operate in units of very large capacity. It is not known how far experimental development along this line has been carried up to the present.

The United States Bureau of Mines, in collaboration with other agencies, is experimenting on a large scale with another method of gasification that has been invented and partially developed by Dr. V. F. Parry. This method is applicable only to sub-bituminous and other low rank coals. It is a continuous process by which the coal is heated through a metal wall by gas that is generated from the residual char from the process. The coal is first carbonized and then reacted with steam in one continuous operation. Tars and other volatile products of carbonization are reacted with steam in a hot zone of the retort so that substantially complete gasification is achieved with good heat economy.

Associated oil interests also propose to use the technique of fluidizing solids for the synthesis step of the process. In the European Fischer-Tropsch process, the removal of heat from the catalyst is accomplished by large steel heat transfer surfaces so that a reaction chamber producing less than one barrel per hour of primary product weighed about 50 tons. The United States interests propose to pulverize the catalyst and pass a stream of synthesis gas through it at such a rate that the catalyst is maintained in the fluidized condition. The space velocity is increased at least tenfold by this procedure and the temperature of the catalyst is almost perfectly uniform. Even more important, the coefficient of heat transfer is increased so that much smaller heat transfer surfaces can be employed. It would appear, therefore, that the amount of steel in the reaction chambers can be greatly decreased by employing the fluidizing technique. Pilot plants are stated to have demonstrated its feasibility. Another approach to the problem of reaction chamber design is being made by the United States Bureau of Mines. They now have an experimental chamber in which the cooling of the catalyst is accomplished by addition of a volatile oil fraction which vapourizes at the desired temperature of reaction and, in vapourizing, absorbs heat. This technique is at present being used with a fixed cobalt catalyst but it is also applicable to other conditions of catalyst, including the fluidized condition described above.

The third major fault of the European process, the nature of the products, can also possibly be corrected. The gasoline produced in the German plants had an octane number of 40 to 50 because it was composed largely of straight-chain paraffin hydrocarbons. Moreover, the yield of gasoline amounted to only about 40 per cent of the total product. By using an iron catalyst and a temperature of about 550° to 600° F., a product can be made which is olefinic and the gasoline fraction of it has an octane number of about 70 which can be increased by adding polymers produced from the gaseous products. About 85 per cent of the total primary product is gasoline and the remainder can largely be converted to gasoline by cracking.

The ranks of coal that are suitable for the Improved Fischer-Tropsch Synthesis depend entirely on the method that will be selected for the primary gasification. Although there are no published data, it is believed that practically any coal can be gasified without technical difficulty by the fluidized process. The Parry process is limited to those coals that produce a char having a high reactivity. This is necessary in order to have the reaction between steam and char proceed at a low enough temperature to allow a metallic heat transfer surface to be used. In general only sub-bituminous coals and lignites can meet this qualification and it may be necessary to differentiate between the more and less reactive varieties within a given rank. Because the newer gasification processes are only in the development stages, it is not possible at present to make any reliable generalization concerning the rank of Canadian coals that would be most suitable.

The nature of the product is independent of the source material so that it is possible to use, as applying to coal, the data that have been given out on conversion of natural gas to gasoline as well as the extremely meagre information that can be obtained on the conversion of coal to gasoline by improved synthesis. Although an iron catalyst is used in conjunction with a higher temperature than in the European Fischer-Tropsch process, the products still have predominantly the straight-chain structure. The principal difference between the older and the improved process is in the degree of unsaturation and in the newer process a very large proportion of the product is olefinic. Because of the high temperature, there is also a considerable proportion of oxygenated compounds in the product consisting principally of ethyl alcohol but containing also small amounts of propyl and butyl alcohols and methyl and ethyl ketones. The boiling range of the primary product is such that about 85 per cent distils in the gasoline range. The remaining 15 per cent is a diesel oil having a cetane number of about 65 which can be used as diesel fuel or can be cracked to yield more gasoline. The primary gasoline has an octane rating by the motor method of 70. When the gaseous products are polymerized and added to the primary gasoline, its octane number is raised to 72 or 73 and, by the addition of 1.2 cubic centimetres of tetraethyl lead per Imperial gallon, the octane number can be raised to 80.

The yield of gasoline and other products that can be obtained from coal by the Improved Fischer-Tropsch Synthesis has been estimated from unpublished data made available to the Commission. For a plant to produce 10,100 barrels per day of synthetic crude oil which is equivalent to 9,900 barrels per day of gasoline, 6,120 tons of coal having a heating value of 13,000 B.t.u. per pound are required. Stated on the same basis that was used for the other processes, 0.62 tons of coal are required to produce one barrel of gasoline. However, in the Improved Fischer-Tropsch Synthesis process as estimated, there would be produced as a by-product a considerable amount of fuel gas and, if this is not sold but is used for fuel, the coal requirement is decreased to about 0.41 tons of coal per barrel of gasoline.

The estimated costs for production of gasoline from coal by the Improved Fischer-Tropsch Synthesis appear to be much lower than those of the European Fischer-Tropsch and hydrogenation processes. The following costs have been supplied for a projected plant.

Plant Capacity—
10,100 bbls. per day....Synthetic Crude (87 per cent Gasoline and 13 per cent Gas Oil)
or
9,900 bbls. per day....Gasoline by cracking Gas Oil
using
6,120 tons per day.....Bituminous Coal (13,000 B.t.u.)

Estimated Capital Cost—
$43,000,000...........(including $1,000,000 for cracking plant)

	Per Calendar Day	Per Barrel Gasoline
Estimated Operating Cost—		
Labour, Supplies and Maintenance	$10,600	$1.06
Gas oil, Cracking Cost	1,010	0.10
Depreciation at 8 per cent	17,000	0.95 (est.)
Other Overhead and Administration		0.77 (est.)
Coal (6,120 tons at $2.50 per ton)	15,300	1.54
Total	$43,910	$4.42
By-Product Credits—		
Tail Gas at 9½ cents per million B.t.u.	*$ 4,800*	*$0.48*
Oxygenated Compounds at 8 cents per barrel Gasoline produced (mainly ethyl and propyl alcohol)	*800*	*0.08*
Total By-Product Credit	*$ 5,600*	*$0.56*
Cost of Producing Gasoline—		
(Operating Cost less By-Product Credits)	$38,310	$3.87

Gasoline Cost of $3.87 per barrel = 9.2 cents per U.S. Gallon = 11.1 cents per Imperial Gallon.

It may be well to add the caution that many of the features of this plant have still to be tested, that it exists on paper only and that the costs apply to United States conditions and are in United States funds. Again recalling the fact that about 1,000 cubic feet of synthesis gas are required for production of one gallon of primary product, it will be seen that the cost figures given above imply a revolutionary improvement in the manufacture of water gas from coal. The improved water gas generator was stated to be based on the fluidizing principle but again was on paper only.

PRESENT INDUSTRY IN OTHER COUNTRIES

The synthetic liquid fuel industry based on coal has, up to the present, been too expensive to compete with natural petroleum on an open market. Where it has been employed, it has been subsidized for the purpose of security in wartime or in order to adjust an unfavourable balance of trade.

Germany

Germany is the only country in which the industry has been extensive enough to approach self-sufficiency. Both the hydrogenation and Fischer-Tropsch processes were invented in Germany and have been in course of development for about 30 years. The first high pressure hydrogenation plant was put into operation in Germany about 1927 and there has been a gradual growth of this industry ever since. The war greatly accelerated the rate at which the hydrogenation industry was expanded. The first full scale Fischer-Tropsch plants were built between 1933 and 1936 and there was considerable expansion of this industry up until 1939. It has remained static during the war with no increase in the capacity of the plants excepting that which was due to improved operating technique.

During 1944 and the early months of 1945, intensive bombing badly damaged all of these plants so that practically no production was obtainable from them. In the British zone of occupation, they have not been repaired for use as fuel producing plants, although their conversion to the manufacture of synthetic ammonia and base materials for the production of edible fats, detergents, etc., has been authorized in some cases. The status of the plants that are in the Russian zone of occupation is not known.

In addition to the full scale plants, there were in Germany numerous research and development organizations devoted to the improvement of the synthetic fuel processes. Of these perhaps the three outstanding organizations were the I. G. Farbenindustrie staff at Ludwigshaven, the Ruhrchemie at Holten and the Kaiser Wilhelm Institute for Coal Research at Mulheim. The Kaiser Wilhelm Institute is the only one that was not damaged by bombing, and since the war, it has continued uninterrupted in its study of water gas synthesis and closely related subjects. On the other hand, the laboratories of the I. G. Farbenindustrie and the Ruhrchemie, which were the sources of information on industrial scale development of hydrogenation and Fischer-Tropsch synthesis, were destroyed and their staffs dispersed so that for some time no valuable information on these processes can be expected from them.

Great Britain

In Britain a synthetic oil industry was not absolutely essential to national security and only one coal hydrogenation plant has been established. This has a capacity of about 3,500 barrels per day of gasoline when coal is used as the raw material. The plant was built by Imperial Chemical Industries and is on the site adjoining their chemical works at Billingham. The plant was protected by a preferential tariff. It operated until 1939 on both coal and tar oils. As

planned, about two-thirds of the gasoline production was from coal and the other third from tar oils. At the beginning of the war, it was converted entirely to the use of tar oils because when these were used as raw materials the capacity of the plant was considerably increased. The product during the war was entirely aviation gasoline.

In addition to this plant, a second hydrogenation plant was built in 1940 at Heysham near Lancaster which also produced aviation gasoline but which used imported petroleum as the raw material. The hydrogenation process was employed because it gives the maximum possible quantity of aviation gasoline from a given quantity of crude oil.

There are no industrial scale Fischer-Tropsch plants in Britain, although small and intermediate scale experiments have been conducted. Perhaps the greatest part of the British research and development work was carried out by Imperial Chemical Industries who had access also to the German and United States data through their association in the International Hydrogenation Patents cartel. Aside from this research, the British Fuel Research Board has conducted small and intermediate scale experimental work on both hydrogenation and Fischer-Tropsch processes beginning in about 1921 and continuing up to the present.

The consensus of opinion in Britain at present is that the industry should not be expanded for the purpose of producing gasoline. This is largely for the reason that coal in Britain is too expensive. There is, however, at the British Fuel Research Board, considerable interest in both processes as a means for producing base chemicals.

France

In France, the synthetic fuel industry was not developed to any great extent. During the 1930's, research and development were carried out, principally by Valette, on a modified hydrogenation process. A large pilot plant was operated according to this process at Bethune in the Pas de Calais area by the Societe des Carburante Synthetiques des Mines de Bethune. The results of this test do not seem to have been encouraging for no larger plant following this process was built.

A Fischer-Tropsch plant was erected at Harnes in 1937 by Etablissement Kuhlmann. This plant was designed to have a capacity of about 600 barrels of primary products per day but achieved a production of somewhat less than 400 barrels per day. It was a conventional atmospheric pressure plant licensed from the Ruhrchemie and operated as described in the section under the Fischer-Tropsch process.

Aside from these two, which cannot be considered as more than large scale experimental or demonstration plants, there has been no development in France. Moreover, there has been less fundamental research on synthetic fuels than in other large, highly industrialized nations. Insofar as is known, there is no important development in progress in France at the present time.

Japan

Japan, like other nations with insufficient oil supplies, made efforts to establish a synthetic fuel industry and there are numerous references in the technical literature to experimental and development work that has been conducted in that country. Moreover, both the I. G. Farbenindustrie and the Ruhrchemie sent technical advisers to Japan to assist in putting synthetic oil plants into operation during the war. It is expected that very soon reports

will be available on the industry in Japan but, up to the present, all that is known is that there were several plants using both hydrogenation and Fischer-Tropsch processes in that country. From information obtained in Germany, however, it is believed that these plants were small, were not entirely successful and were based on German design with little or no original Japanese modification.

United States

In the United States, there are no industrial scale synthetic oil plants based on coal. The Standard Oil Development Company, however, made an agreement with I. G. Farbenindustrie in 1927 regarding applications of hydrogenation to various phases of petroleum refining and in 1930 erected two plants at Bayway, New Jersey, and Baton Rouge, Louisiana, respectively, for refining of lubricants and other processes involving hydrogenation. During the war, the Baton Rouge plant is believed to have been used for the production of aviation gasoline from petroleum stocks.

Beginning in 1935, the United States Bureau of Mines undertook research on hydrogenation of coals and has increased the scope of this work continuously since that time. More recently a parallel investigation of the Fischer-Tropsch type of synthesis has also been conducted. In 1943, the United States Bureau of Mines considered that the pace of these investigations should be greatly accelerated because it was realized that, within foreseeable time, the United States might be dependent upon imported petroleum. For this reason a Bill, No. 1243, was passed by Congress authorizing the Bureau of Mines to spend $30,000,000 on an investigation of means for producing petroleum substitutes from coal, oil-shale, and other materials.

In addition to the interest of Government organizations, the oil industry is also active in development work on substitute liquid fuels. At present the greatest activity is in the field of production of gasoline from natural gas by hydrocarbon synthesis, but, as a longer term project, the oil industry is also studying means of utilizing coal as a primary raw material. Part of this work has been summarized briefly in the previous section under Improved Fischer-Tropsch Synthesis.

Italy

In Italy, there were no synthetic oil plants based on coal, but two full scale oil hydrogenation plants were built, one at Bari on the Adriatic, and the other at Leghorn. These plants were both built to designs supplied to the Italian company by the I. G. Farbenindustrie.

COMPETITIVE RAW MATERIALS

Natural Petroleum

Indigenous

Of the raw materials that are competitive with coal as sources of liquid fuels, petroleum is, of course, the most important. Statistics on Canadian requirements and production of petroleum are in the chapter Sources of Energy. Summarizing them very briefly, in 1944 the requirement of petroleum for all of Canada was roughly 180,000 barrels per day, and Canadian production was 27,420 barrels per day. Canadian production is practically all from the Prairies and Northwest Territories.

During the war years, there was unusually intensive exploration in Alberta, but this did not result in the discovery of any major field. Exploration is

expected to continue but, of course, there is no reliable method of predicting what its result will be. Indigenous petroleum, therefore, is not now the major competitor with coal as a source material for liquid fuels. If, for any reason, it should be necessary or desirable to place Canada in an independent position as regards liquid fuels, the industry, failing new discoveries, would have to be based on some raw material other than petroleum.

Foreign

In 1944, more than 150,000 barrels per day of crude petroleum were imported into Canada. In the chapter Sources of Energy, there is a brief review of the fields from which this petroleum came, and of the proven reserves in various parts of the world. It appears that within the near future, the United States will become on balance an importer of petroleum, and Canada will probably have to turn more and more to other countries for her requirements. If there is free access to the fields in South America and the Middle East, no major readjustment in the Canadian petroleum industry would appear to be necessary. However, the possibility that the North American continent may soon be less than self-sufficient with respect to petroleum raises consideration of future security, which might in time justify the establishment of a synthetic petroleum industry on a subsidized basis.

One possible development in the petroleum industry is the application of the hydrogenation process to increase the yield of gasoline from crude petroleum. It is argued in some quarters that it may be more practical to convert petroleum almost entirely to gasoline and light fuel oils and to substitute coal directly for heavy fuel oil than to convert coal to gasoline. This possibility was emphasized in the hearings on Bill 1243 before the United States Senate Committee. The effect of a policy based on this consideration would be to delay somewhat the development of a synthetic liquid fuel industry based on coal.

Natural Gas

The second raw material to be considered in competition with coal for the production of liquid fuels is natural gas. As mentioned earlier, the United States oil industry is now developing a method based on hydrocarbon synthesis for conversion of natural gas to gasoline. The United States oil industries claim to have developed a new process for hydrocarbon synthesis to the point where a full scale plant can be built. The main features of the process appear feasible, and the cost estimates are lower than for any other synthetic method, but the process cannot be accepted without reserve until it has been established on a full scale, or until complete details have been made available for criticism. If, as seems possible, the process should be technically and commercially successful, it will be necessary to find and allocate to this use a sufficient quantity of natural gas.

The reserves and production of natural gas in Canada are discussed in the chapter Sources of Energy. Only in Alberta are the reserves of natural gas sufficient to warrant consideration of a synthetic liquid fuel industry based on them. It appears that there is at present a good deal of interest in the feasibility of such an industry in that Province. It is important to recognize, however, that irrespective of its local importance, such an industry could not contribute a very large proportion of Canada's liquid fuel requirements unless the volume of natural gas made available to the industry becomes very much greater than is thought at present to be available. If the total production of natural gas in Alberta, including gas which was wasted, were diverted to a synthetic fuel industry, it could supply a plant having a capacity of some 11,000 barrels per day, that is, it could supply only about 7 per cent of Canada's liquid fuel requirements. It is probable that at the present time proven reserves in

Alberta would justify a plant not much larger than 5,000 barrels per day. Whether a synthetic liquid fuel industry based on natural gas will develop in Alberta is, of course, highly uncertain.

Bitumen

The bituminous sands of the McMurray area in Alberta are a third raw material to be taken into consideration as a possible competitor with coal in the production of liquid fuels. These are beds of sand, the grains of which are coated with an extremely heavy asphaltic oil. Unlike most oil-bearing sands, the McMurray occurrences are partly at, or near, the surface. The sand can be mined by open-cut methods and the bitumen removed from it by washing with hot water or by other means. The separated bitumen can be converted to an equal volume of gasoline by hydrogenation, and to fuel oils, asphalts, etc., by other processing methods.

The bituminous sands have attracted wide-spread interest, chiefly because of their large quantity. The amount of bitumen in the whole occurrence has been estimated at 100 to 200 billion barrels, a figure the magnitude of which can best be grasped by comparison with the world's known petroleum reserve which is 50 billion barrels. Although the magnitude of the quantity is impressive, it is, however, entirely without commercial significance unless the bitumen can be produced and refined to marketable products at competitive costs. Commercial ventures in mining and separation have not, up to the present, been successful financially, or completely successful even technically. Nevertheless, improved methods of mining and recovery, and also of refining and transportation, may bring costs of gasoline and other products from bitumen down to the point where they can compete with those from petroleum imported into the Prairie area from long distances or with synthetic products made from coal. There is not enough reliable information on methods of recovery of bitumen from the sand or on refining methods to make a satisfactory assessment of its future possibilities and further development work in both these fields is needed.

POSSIBLE FUTURE OF SYNTHETIC LIQUID FUELS FROM COAL

Improvement of Methods

None of the process modifications that have been established on a commercial scale has been able to produce gasoline from coal at a cost that is competitive with that of petroleum-produced gasoline. The question arises, therefore, of the possibility that technological improvements in the existing processes or invention and development of radically new methods will make it possible to produce gasoline from coal in competition with petroleum at its present price.

To answer this question, let us first examine the energy conversion of the more efficient of the established processes. When 0.6 tons of bituminous coal is converted to one barrel of gasoline, the energy conversion is somewhat less than one-third; that is to say, two-thirds of the energy of the raw materials are lost in the process of making gasoline from coal. In this respect, therefore, there is theoretically much room for improvement.

Secondly, considering the influence of the cost of the raw material upon the cost of the final product, the table below gives the part of the cost of gasoline that is chargeable to coal as a function of cost and rank of the coal. In preparing the table, it is assumed that, to produce one barrel of gasoline, the total requirement including fuel, etc., was 0.6 tons of bituminous, or 1.0 ton of sub-bituminous coal or 1.4 tons of lignite (30 per cent moisture) or 1.8 tons of brown coal (50 per cent moisture). These assumptions are, of course, somewhat arbitrary

and correspond roughly to hydrogenation practice in Europe. They set bituminous coal at $5.00 per short ton as equivalent to sub-bituminous coal at $3.00, lignite at $2.12 and brown coal at $1.67.

Cost of Coal $. per Short Ton	Costs Chargeable to Coal in Cents per Imperial Gallon of Gasoline			
	Bituminous	Sub-bituminous	Lignite (30 Per Cent Moisture)	Brown Coal (50 Per Cent Moisture)
1	1.7	2.9	4.0	5.1
2	3.4	5.7	8.0	10.3
3	5.1	8.6	12.0	15.4
4	6.9	11.4	16.0	
5	8.6	14.3		
6	10.3			

It will be seen from these considerations of energy efficiency and cost of coal that it would be incorrect to dismiss the possibility that some improved process may be able to make gasoline from coal as cheaply as it is now made from petroleum, on the grounds of raw material cost alone.

Technical difficulties, however, are another matter and it is well to bear in mind that the synthetic fuel industry has been undergoing constant development for more than thirty years by some of the best technical organizations in the world, whose expenditures for development in Germany and elsewhere, are in the order of hundreds of millions of dollars. It is, therefore, difficult to make any satisfactory estimate of the probability that future processes will be improved enough to make coal competitive with petroleum at its present price as a source material for liquid fuels.

Significance of a Deficiency of Petroleum

If it is assumed that coal will never be able to produce gasoline and other liquid fuels as cheaply as they are now made from petroleum, the next question to be considered is how long the cost of petroleum products will remain at the present level. Although there are many factors that have to be taken into consideration in answering this question, the central one is undoubtedly the question of the world's resources of petroleum. It has been shown that the total proven reserve for the whole world as of 1945 was about 50 billion barrels and that in 1945 daily consumption was 7,580,000 barrels. If the world reserve were an accessible reservoir that could be tapped at any desired rate, if no more discoveries were made, and if production remained constant at the level of 1945, the present reserve would be completely exhausted in about 18 years. However, oil fields cannot be tapped beyond a certain optimum rate so that if no more oil were discovered a shortage would be imminent. On the other hand, there is a high probability that extensive new fields will be discovered, especially in the Middle East. In the face of this situation, any course of action that is taken must be based upon uncertainty rather than on the assumption either of continuing sufficiency or imminent deficiency.

In considering the cost of petroleum, the cost of transportation to the consumer must be added to the price at the well. If, for any reason, the supply of petroleum were even slightly inadequate, the general price level would rise to the point where substitutes could compete to make up for the deficiency. Where substitute raw materials are available, the competition would be with the total cost of petroleum including transportation charges. For this reason, the first truly economic use of substitute fuels will be in an area deficient in petroleum and into which the transportation cost is high. Such an area exists in the Prairie Provinces, especially in Alberta, although in Alberta the situation is complicated by the presence of natural gas and bitumen in addition to coal as

substitute raw materials. However, establishment of a synthetic fuel industry in an area where it would be protected by a high transportation cost involves the economic risk that a new oil field might be discovered in the area after the synthetic industry had been established in it. This risk is especially great in the Canadian midwest where much of the territory is potentially oil-bearing.

In wartime, or time of similar crisis, a different set of conditions arises; transportation may be not only costly but completely obstructed and at the same time the value of petroleum products is enhanced. There are, however, three major shortages which always attend wartime economy which would render it difficult, if not impossible, to establish a major synthetic fuel industry or a major addition to one already existing after hostilities had begun. The first shortage to be considered is steel. The presently existing synthetic oil processes require approximately 10 tons of steel per barrel per day of gasoline-producing capacity. To replace 10 per cent of Canada's requirement—180,000 tons of steel would, therefore, be required. As a further example, considering the position of the United States, Dr. H. H. Storch, of the United States Bureau of Mines, has estimated that "...to fabricate all of the plants necessary to produce the equivalent of our present petroleum consumption of 1.4 billion barrels per year, would require about 10 years of work by all of the fabricating companies now in existence in the United States...it is, of course, impractical to use the entire fabricating capacity of the United States for synthetic fuel plant construction, and it is, therefore, apparent that 30 to 40 years may be required for the completion of all the necessary plants. . .". Secondly, in wartime, there is always a labour shortage and it is extremely doubtful that a sufficient force of skilled labour could be provided to construct and erect a synthetic fuel industry of any significant size within a reasonable time. Thirdly, in wartime, the need for a synthetic industry would be urgent and even granted ample supplies of steel and of labour, a single synthetic oil plant of commercial scale cannot be planned, designed and erected in less than 2 or 3 years. For these reasons, therefore, if synthetic oil is to be available during a war, the condition of deficiency must be foreseen long in advance and the industry must be established gradually and slowly over a long period of years in peacetime.

Combination with Coke and Gas Industries

In attempting to forecast the future course of the synthetic liquid fuel industry, it has been suggested that there are possible combinations of synthetic processes with the already established gas and carbonization industries that might improve the economic outlook for both. One such suggestion is that a gas plant employing total gasification of coal be operated in the winter to supply gas for domestic heating and in the summer to supply water gas to a hydrocarbon synthesis plant. This combined operation does not appear to be economically sound because of the high capital cost of the synthesis plant. If a winter peak load must be met by a gas plant, it would be cheaper to have excess gas manufacturing capacity which would be idle in summer than to erect a more expensive synthesis plant which would be idle in winter.

Another suggestion is that hydrogenation and coking be combined in such a way that the coke oven gas is used for manufacture of hydrogen, the coal tar in addition to raw coal is converted to gasoline and the heavy pitch, which is one of the products from the first stage of hydrogenation, is carbonized with coal. This combination appears to offer numerous advantages over simple hydrogenation, but is subject to the fundamental fault that two major products are made, namely, coke and gasoline, and the size of the plant would be limited by the market for coke. Even overlooking this disadvantage, it does not seem probable that a flow sheet could be worked out which would enable this process to compete with natural petroleum under present conditions. This type of combination, however, merits study.

General Conclusions

This concludes a technical and economic review of problems relating to the production of synthetic petroleum from coal by the three processes that are now recognized, viz., high pressure hydrogenation, the European Fischer-Tropsch process and the Improved Fischer-Tropsch Synthesis. It is obviously a subject that should continue to receive consideration by the public generally, and at least selective research (having regard to the magnitude of the cost of comprehensive research) must be a matter for consideration.

The principal economic factors governing the commercial development of a synthetic liquid fuel industry are the cost of the raw material, the size of the market, and the price of gasoline. It is desirable to emphasize at this point that low cost coal is of primary importance in the development of a synthetic fuel industry based on coal and that any developments in this field will not relieve the mine operators from the need to improve the efficiency and cut the cost of coal production. The low productivity and high costs of Maritime coals are serious impediments to the development of a synthetic liquid fuel industry based on coal in that area. The prospects of synthetic fuel production, not necessarily based on coal, are somewhat more favourable in the Prairie Provinces than in the Maritimes. The price of gasoline is relatively high, the cost of raw materials is moderate and the market, while restricted, might be sufficient for a small industry. Any such development presupposes that there will be no discovery of new large oil fields in this area, which is by no means certain. Moreover, if a synthetic fuel industry does develop it may be based on raw materials other than coal. If the natural gas reserves of Alberta and Saskatchewan prove adequate, these may be used rather than coal. Failing this, the industry may be based on the bituminous sands of Alberta. Consideration of alternative raw materials emphasizes the necessity of increased efficiency in coal production if a synthetic fuel industry based on coal is to develop. In any event, further technical research is required before any synthetic fuel industry can be developed on a commercial scale in Canada.

CHEMICAL INDUSTRIES BASED ON PRODUCTS FROM COAL

As stated in the introduction to the chapter, this section deals with those industries which are based on products from coal. These industries are distinguished by two salient facts—*(a)* their main products are not used as fuels, *(b)* they use coal products as a raw material from which they produce or process chemicals containing carbon. For convenience of discussion, the industries concerned may be subdivided into main groups and sub-groups as follows:

(1) Industries based on the use of coke as a raw material.
   (a) Electro-thermal industries,
   (b) The synthetic chemical industries.

(2) Industries based on by-products arising from the coking of coal.
   (a) The chemical aspects of the gas and coke industry,
   (b) The coal tar distillation industry,
   (c) The synthetic coal tar chemical industries.

The value of the coal products as a raw material for all these industries lies in the fact that these coal products are a convenient source of carbon or of chemicals containing carbon. As a building product for the chemical industries, coal products may be utilized in the following ways:

(1) As Coke—Coke is one of the main raw materials in the electro-thermal industries, where it may play the role of a reducing agent or may actually enter into the final product. It is also a source of carbon monoxide.

(2) As Carbon Monoxide—Carbon monoxide is an important raw material in the synthetic chemical industry. It is an indirect source of hydrogen and ammonia. It is a direct source of synthetic methyl alcohol and other similar chemicals.

(3) As By-products in the Manufacture of Coke—Coal tars are the source of creosote and pitch, as well as some organic products, such as naphthalene and carbolic acid. The light oils provide substantial amounts of benzene, toluene and xylene, from which many organic chemicals are synthesized. Ammonium sulphate, for use as a fertilizer, is also obtained from this source.

The non-fuel use of coke from coal in the chemical industries in Canada accounts for less than 1 per cent of the total coal consumption. Less than one half of the coke so used is made from Canadian coal. It is therefore apparent that the non-fuel coal requirements of the chemical industries are almost negligible.

In the manufacture of organic chemicals there are two main sources of raw material other than coal or its derivatives. All three sources are competitive, for most compounds can be made from any one of the sources of carbon. The sources alternative to coal are petroleum products, including natural gas, and vegetable matter. In Canada the synthetic rubber industry is based on petroleum products, and one large synthetic ammonia plant is based on the use of natural gas. There is also a large fermentation industry which produces organic solvents, including ethyl alcohol, butyl alcohol, and acetone. Many synthetic chemicals are derived from these products. Likewise there exists a wood distillation industry which produces organic chemicals.

Acetone provides a good example of a chemical which may be produced from several alternative raw materials. It can be manufactured

(a) from refinery gases
(b) from calcium carbide produced from coke
(c) by fermentation of corn
(d) from ethyl alcohol produced from molasses
(e) by wood distillation.

All the industries are naturally dependent on the existence of markets for their products. In most cases these markets are world-wide markets and the products must meet world-wide competition. Canada is not a large user of chemicals and there is, therefore, an insufficient domestic market for the products. Another factor affecting the marketing of the products of these industries is the fact that in the production of a desired product there are frequently inevitable by-products which must also be marketed to allow the industry to survive. In the synthetic chemical industries, both those based on coke and coking by-products, the carbon which enters into the finished product is but one of many raw materials which are required. Adequate supplies of these other raw materials must be available to permit the establishment of these industries. Typical other raw materials required are chlorine, limestone, ammonia, soda ash, caustic soda, et cetera. Cheap power may also be considered as a raw material and is essential to the operation of most of these industries. The size of the industries based on by-products of coking depends upon the size of the coke and gas industry. The very large coke and gas industry in the United States, based largely on the demand for metallurgical coke, permits a much larger by-product chemical industry than is possible in Canada. These economic factors are of fundamental importance. The mere availability of coal, coal products, and coal by-products is by no means sufficient in itself to warrant the establishment of any of these industries.

INDUSTRIES BASED ON COKE AS A RAW MATERIAL

Electro-thermal Industries

The electro-thermal industries process coke in electric furnaces to produce such carbon compounds as calcium carbide, silicon carbide, graphite, etc. These industries also use coal products in the form of electrodes required for electric furnace operation.

The industries which produce calcium carbide and calcium cyanamide and their derivatives are among the largest units of the chemical industry in Canada. Calcium cyanamide is not itself produced in an electric furnace, but because it is made from calcium carbide it will be discussed here.

Calcium carbide is formed by the reaction of lime and carbon in an electric furnace. The commercial manufacture of calcium carbide requires a large supply of low cost electrical power and, therefore, its production is usually carried on adjacent to hydro-electric power sites. Carbide was first produced in Canada in 1904, and its manufacture has been a steadily expanding industry. Manufacture in Canada is largely centred at Shawinigan Falls, P.Q., but there is also a small production at Welland, Ontario. Calcium carbide reacts with water to form acetylene, which was originally used for illuminating purposes and for oxy-acetylene welding. It continues to be used for these purposes, but large quantities of acetylene are now converted to other chemicals. During World War I acetylene was used to produce acetone, which was required as a solvent in explosives manufacture. From this original operation an increasingly wide range of chemical products has been produced. Among the important chemicals produced from acetylene prior to 1939 were acetone, acetic acid, acetic anhydride, ethyl acetate, acetylene black, trichlorethylene, and an important series of resins used in the production of plastics. As a result of the war, facilities for the production of these products were expanded and manufacture of butanol, polyvinyl chloride and hexachlorethane and other products was undertaken in Canada.

Based upon low cost hydro-electric power and the resulting low cost carbide, a large export market was developed prior to the war for both carbide and the chemicals derived from acetylene. As a result of the war, this export market was greatly expanded. It seems probable that a substantially larger post-war domestic and export market might develop. On the other hand, synthetic chemicals based on the by-products of the petroleum industry are providing increasing competition, and while this competition is not yet an important factor in the domestic market, it has affected the export market and may eventually make itself felt in the domestic field.

The operations at Shawinigan Falls have in the past provided a market for from 50,000 to 100,000 tons annually of Nova Scotia coal. Shawinigan Chemicals Limited, at Shawinigan Falls, has developed a low cost method of making coke from bituminous coal for use in their carbide furnaces. Their plants use either coal coke, petroleum coke, or bituminous coal, depending on current price and availability. The Electro-Metallurgical Company of Canada at Welland, Ontario, depends on United States supplies.

Calcium cyanamide, commonly known as cyanamide, is manufactured from calcium carbide by passing nitrogen from the air through ground carbide under carefully controlled conditions. Until the development of the synthetic ammonia processes, cyanamide was the chief source of fertilizer containing nitrogen obtained from the air. The plant of the North American Cyanamid Company, at Niagara Falls, Ontario, was first established in 1909 and since that date has been the sole producer of cyanamide in North America and in the British Empire. In 1944 this plant used about 100,000 tons of coke as raw material, nearly one-quarter of which was petroleum coke. In addition to its

use as a fertilizer, cyanamide has been for some years one of the main sources of cyanide used in the extraction of gold from its ores. More recently, a number of important chemicals has been developed from cyanamide as a raw material, among these being melamine, an important synthetic resin. As part of the war programme, manufacture of dicyandiamide, guanidine nitrate, and nitroguanidine were undertaken at Niagara Falls, Ontario, using cyanamide as a raw material. While manufacture of the latter, an important military explosive, has ceased, the production of the other two is being maintained, mainly for export to the United States for the production of melamine. Expansion of the use of cyanamide as a chemical raw material will be largely dependent upon export markets for the resulting chemical products. The continued use of cyanamide as a fertilizer will be largely dependent upon its ability to compete with other synthetic fertilizers.

Silicon carbide, known as carborundum, is produced by heating coke and sand in an electric furnace. Carborundum is practically as hard as diamond and is, therefore, extensively used as an abrasive. Other abrasives, such as aluminum oxide (alundum), do not contain carbon, although carbon is used in their manufacture—principally in the form of electrodes. There are in Canada three plants using carbon in the manufacture of abrasives—two in the Niagara district and one at Shawinigan Falls. The industry consumes about 25,000 tons of coke per year (not all of it from coal) and is dependent on low cost hydro-electric power.

Artificial graphite is made in an electro-thermal furnace by heating coke to a very high temperature. The ash is volatilized and the remaining product is pure carbon in the form of graphite. The best known use for graphite is as a dry lubricant.

Synthetic Chemical Industries

These industries are based on synthesis gases produced by the controlled combustion of coke or natural gas. The synthesis gases are mainly mixtures of carbon monoxide and nitrogen, or of carbon monoxide, nitrogen and hydrogen, depending upon the method of production. From synthesis gases a wide range of chemicals can be made, among those commercially feasible being ammonia and synthetic methanol (wood alcohol).

These synthetic chemical industries owe their existence to the work done by the Germans prior to World War I. In 1913 the Badische Anilin and Soda Fabrik installed the first commercially successful plant for the manufacture of synthetic ammonia. The ammonia was used to produce nitric acid which is essential to the manufacture of high explosives. Thus the development of synthetic ammonia in Germany is credited with enabling that country to wage World War I.

Ammonia is produced by the reaction of three parts of hydrogen and one part of nitrogen passed at high pressure over a suitable catalyst. The hydrogen required may be produced by the electrolysis of water or by the decomposition of steam using coke or natural gas. Nitrogen may be obtained either from producer gas or by the liquefaction of air. When the production of ammonia is based on coke, about 1.3 tons of coke are used per ton of ammonia produced. The current trend in the synthetic ammonia industry is towards the use of natural gas rather than coke.

Prior to World War II the synthetic ammonia capacity of Canadian plants was about 35,000 tons per year, all of it based on electric power. In 1945 the rated capacity was about 180,000 tons of which 30 per cent was based on coke (equivalent to a maximum of 80,000 tons of coke per year), 40 per cent was based on natural gas and the remaining 30 per cent was based on electrical energy. The largest ammonia plants in Canada are situated at Trail, Calgary and Welland. The Trail plant uses coke and electrical energy, the Calgary plant uses natural gas and the Welland plant uses coke.

The main peacetime use of ammonia is to make ammonium nitrate for use as a fertilizer. Plant capacity in Canada was expanded substantially during World War II to provide ammonia for explosives but at present the plants must rely principally upon an export market for fertilizer.

Methanol is synthesized by the reaction of carbon monoxide and hydrogen in a process similar to that used for production of ammonia. There is no plant in Canada producing synthetic methanol. Very high capital costs and large volume production are essential to the establishment of these synthetic industries. The urgency of wartime demands justified the great expansion of the synthetic ammonia industry and provided essential markets. Such has not been the case with regard to methanol production. Its synthetic production in Canada must await more favourable conditions.

INDUSTRIES BASED ON BY-PRODUCTS ARISING FROM THE COKING OF COAL

Three different types of industries are concerned in the recovery and refining of the by-products arising from the coking of coal. They are:

(1) The gas and coke industries.

(2) The coal tar distillation industry.

(3) The synthetic coal tar chemical industries.

In 1845 Hofman proved the existence of benzene in the light oil derived from coal tar. It was this discovery which first established coal tar as a chemical raw material and laid the foundation for the so-called coal tar chemical industry that was to follow. It was not until after 1876 that benzene was discovered in coal gas and the recovery of light oil as a source of benzene was commenced. Although light oil subsequently replaced coal tar as the principal source of benzene, coal tar continued to receive the credit for being the source, not only of benzene, but of other light oil constituents such as toluene and xylene and all organic compounds derived from these components of light oil. Today, about 60 per cent of all so-called coal tar synthetic organic chemicals are derived from benzene, toluene, and xylene, and, although these parent substances come almost entirely from light oil and not from coal tar, they are regularly classified as coal tar chemicals.

Chemical Aspects of the Gas and Coke Industry

The main by-products of the coke and gas industry are ammonia, light oils, and coal tar, which are now recovered from some 80 to 85 per cent of the coal coked in Canada. The gases from the coking operation are first cooled by spraying water into the gas-collecting mains. This cooling causes the separation of some tar from the gas and also dissolves part of the ammonia in the spray water. Further cooling is carried out in equipment known as primary coolers where the gases are passed over water-cooled tubes or subjected to further water sprays. Final traces of tar in the gases leaving the primary coolers are removed by mechanical or electrical means. Any ammonia remaining in the gas may be removed by further water-washing or by reaction with sulphuric acid to produce ammonium sulphate. Nearly all the ammonia produced by the coking industries is recovered as ammonium sulphate. The tar and water which has been accumulated in the collecting mains and coolers is run to storage tanks where the tar and aqueous layers are separated. The aqueous layer is treated for recovery of ammonia and the tar is sold to tar distillers or is burned as a fuel.

After removal of ammonia and tar, the gases are passed through towers countercurrent to a stream of "wash oil". The wash oil is usually a heavy petroleum oil. This operation removes the light oils from the gas. These

light oils are a mixture of benzene, toluene, and xylene, which are all soluble in the wash oil. It may be desirable to purify the gases further by the removal of other impurities such as sulphur, and this is sometimes done, though none of these further by-products is recovered in Canada. With or without this final purification, the gas is used as an industrial and domestic fuel.

The light oils, benzene, toluene, and xylene, may be removed from the wash oil by distillation. The wash oil is then ready for further use. By re-distillation the constituents of light oil may be separated one from another to whatever degree of purity is justified by market conditions.

The by-products of the Canadian coke and gas industry for 1939 and 1943 were as follows:

—	Coal Tar	Light Oils	Ammonia
1939	27 million gallons	7 million gallons	8 thousand tons
1943	36 million gallons	8 million gallons	9 thousand tons

These by-products represent about 8 to 10 per cent of the weight of the coal coked. The ammonia was almost entirely converted to ammonium sulphate and sold as fertilizer. The light oils were refined and sold as benzol, toluol, xylol, and solvent naphthas. The main outlet for these refined light oils is the synthetic chemical industry. Thus, the coke and gas industry produces ammonium sulphate as a finished product and coal tar and refined light oils as raw materials for other industries.

The Coal Tar Distillation Industry

Coal tar is a black, fairly viscous, liquid. Its chemical composition depends on the manufacturing methods which produced it. The size and type of coal coked, the type of oven or retort in which the coal is carbonized, the temperature prevailing during the coking operation, have far reaching effects on the nature of the tar produced. The composition and geographical location of various tars will naturally determine the products to be obtained and the processing methods to be used.

The first step in coal tar refining is the distillation of the crude coal tar to produce refined tars or pitch, and distillate products. The percentage of the volatile constituents distilled off is determined by the type of crude tar used and the type of tar or pitch residue desired. Preliminary refining equipment is generally a simple batch still—that is, a closed vessel which is partially filled with tar and then heated to distil off low-boiling products until the tar or pitch residue has reached the required consistency or melting point. The tar or pitch residue is then drawn off from the still and cooled. The distillates are condensed to oily liquids. The oils distilled off at different temperatures may be collected in separate tanks where they are available for further processing. In this further processing the economically recoverable chemicals are removed. The remaining distillates are blended to specifications and sold as creosote oil.

The main chemicals which are recoverable from coal tar in commercial quantities (pre-supposing the removal of ammonia and the light oils) are naphthalene, phenanthrene, anthracene, tar acids, and tar bases. Of these, only naphthalene and tar acids are recovered in Canada. All these chemicals constitute not more than 15 to 20 per cent of the tar. The tar, in turn, represents not more than about 5 per cent by weight of the coal coked, so that the production

of coal tar chemicals from coal would be at best in the order of 0.75 per cent to 1 per cent of the coal coked. The inclusion of ammonia and the light oils would raise the percentage of recovery of chemicals from coal to about 2 per cent.

The production of chemicals is not an essential part of the coal tar distillation industry. As a matter of fact, in Canada and the United States at least 95 per cent of the products produced from coal tar are sold as crude distillates or residues.

The Canadian production of coal tar is insufficient to supply the needs of the industry. In 1939 it was necessary to import over 3,000,000 gallons of tar and in 1943 over 6,000,000 gallons from the United States.

In 1943 over 9,000,000 gallons of creosote were supplied to creosoting plants for the preservation of railway ties, telegraph and telephone poles and structural timber. Over 85,000 tons of pitches were produced. A very large proportion of these pitches was used in the manufacture of electrodes for the production of aluminum. Additional amounts were used for roofing. Some 16,000 tons of pitch coke were supplied for the manufacture of abrasives and 180,000 gallons of tar acids and over 6,000 tons of naphthalene were recovered.

Tar acids are a complex mixture of acidic chemicals, of which the best known is carbolic acid. The tar acids are used either directly for manufacturing disinfectants or as raw materials for products made by the synthetic coal tar chemical industries. Phenol is also used for the purification of lubricating oil. Naphthalene was once important as a moth repellant. Its main use now is as a raw material for the manufacture of other chemicals.

Coal tar distillation plants are operated in Canada by the following three companies: Dominion Tar and Chemical Company Limited at Sydney, Montreal, Toronto, Sault Ste. Marie and St. Boniface, the Barrett Company at Montreal and Toronto, and Currie Products Limited at Ottawa and Hamilton. Barrett Company and Currie Products Limited produce mainly road tars, roofing pitch, paving tars, and saturants for building products. No chemicals are recovered from the small amount of distillates. Dominion Tar and Chemical Company refines most of the tar processed in Canada. Creosote, pitches, road tars, and pitch coke are the main items produced. This Company is the only one equipped for the extraction of coal tar chemicals.

Synthetic Coal Tar Chemical Industries

These are the industries which use benzene, toluene, xylene, tar acids, naphthalene, and other chemicals directly recoverable from light oils or coal tar as raw materials for the production of new chemicals. It is to be noted that these raw materials obtained from coal are by-products of the gas and coke industries and that it is not economically feasible to coke coal for the specific purpose of producing these chemical raw materials. It has already been pointed out that the complete recovery of the chemical by-products of coal would amount to not more than 2 per cent of the weight of coal coked. Furthermore, a large number of other raw materials provided by other chemical industries must be available before the synthetic chemical industries can produce the dyes, pharmaceuticals, disinfectants, resins, insecticides, plastics, et cetera, which we commonly hear spoken of as being obtainable from coal. In many cases a number of intermediate products must be manufactured before obtaining the desired final product.

A typical example of the complexity of these operations and their relationship to the coal by-product chemicals is the manufacture of synthetic rubber as made by the Polymer Corporation at Sarnia. Benzene and ethylene are reacted to form ethyl benzene, which is in turn converted to styrene. Butane,

a petroleum product, is converted to butylene and thence to butadiene. The styrene and butadiene are reacted together to produce synthetic rubber as Buna S. Thus, the benzene is but a fraction of the raw material required and is many operations removed from the final product.

The manufacture of nylon provides another example of the complexity of producing a final product from a raw material which is originally obtained from coal. Nylon can be produced from phenol, which is obtainable from coal tar, but there are a number of intermediate steps, involving complex and expensive operations. To make nylon, phenol is first converted to cyclohexanol which is converted to adipic anhydride, from which adipic acid is produced. Adipic acid is one of the direct raw materials for making nylon. The other one is hexamethylenediamine, which is made by treating adipic acid with ammonia to form a dinitrile, which is then converted to hexamethylenediamine. The two raw materials are then reacted together to give nylon, which must then be processed into the form of a fibre before it is available to the textile trade. Thus, no less than five intermediate products must be manufactured and processed to acquire even the raw materials for making nylons. The complexity and scale of the direct and subsidiary operations required to produce nylon are such that it is not commercially feasible in Canada. The only part of these operations carried on in Canada is the production of nylon textiles from imported crude nylon.

The existence of these synthetic industries has practically no effect on the amount of coal coked. They merely provide a market for by-products which are inevitably produced when coal is coked for the purpose of obtaining coke or gas.

GENERAL CONSIDERATIONS

We have stressed that the nature of the chemical industry in any area depends upon the available sources of carbon and of other necessary raw materials and upon adequate markets. Variations in these factors explain the differences in the chemical industries in different countries.

Britain's chemical industry is, for the most part, based on coal and the traditional fermentation and distillation processes. The high cost of coal has encouraged the search for alternative sources of carbon, and because of the lack of large amounts of surplus agricultural products there has been a trend towards increasing reliance on imported petroleum products as raw materials.

Germany's whole chemical economy was based on coal. The huge steel and coke industry assured the country of large supplies of coal tar and other by-products as chemical raw materials. Lacking petroleum products and having barely enough foodstuffs to feed the population, the country turned increasingly to coal as a source of liquid fuels, textiles, edible fats, synthetic rubber, and many other products.

United States has virtually all the raw materials for a successful chemical industry—petroleum products, coal, coal tar, agricultural products, sulphur, salt and many others. The United States synthetic rubber programme was based primarily on petroleum derivatives with supplementary supplies of other raw materials, notably alcohol from corn fermentation and acetylene and acetaldehyde from calcium carbide. The tendency to-day appears to be to manufacture organic chemicals from petroleum products. This is governed by purely economic considerations. The ammonia, methanol, and formaldehyde industries are strongly entrenched behind cheap coal. The availability of large amounts of coal tar and other by-products from the coke industry is a determining factor in the American production of synthetic organic chemicals.

The Canadian chemical industry has been handicapped by a small domestic market, but it has taken advantage of the availability of cheap hydro-electric power and of certain raw materials to secure export markets in specialized lines. The size of the chemical industries based on the by-products of coking is, of course, limited by the size of the coke and gas industry. This industry is not large in Canada, and there is no prospect of it being substantially expanded. The future development of the chemical industries in Canada will depend very largely on export markets, and it is unfortunately true that the areas most suited for cheap manufacture of chemicals are not well situated for export. The chemical industries using coal products as raw materials have not so far been important users of coal, and there seems little prospect that they will become so. The chemical industries most likely to expand are those based on either natural gas or imported petroleum products.

CHAPTER XII

GOVERNMENT IN RELATION TO THE COAL INDUSTRY

This chapter will treat briefly with the legislative authority of the Dominion and the provinces, will give a short summary of the activities of the provinces in relation to coal with some reference to existing legislation in that sphere, and will refer more specifically to the activities and the relevant legislation of the Dominion. As the Canadian coal industry, like many another industry, owes its present position to the various measures of control established during World War II, it will also trace the development of the general controls and will examine in greater detail the activities of Coal Administration and Coal Control. Some details of receipts and expenditures of the provinces with reference to coal will be given, as will the cost to the Government of Canada of the various subsidies paid during and since the war, and the cost of administering the wartime control of coal.

Constitutional Aspects

The British North America Act divides the entire field of legislative jurisdiction between the Parliament of Canada and the provincial legislatures. Section 92, the section which sets out the spheres of exclusive legislative authority of the provinces, assigns to them power to legislate concerning the "management and sale of the public lands belonging to the province" and legislative authority over "property and civil rights in the province" and "matters of a merely local or private nature in the province". As interpreted by the Courts, this includes jurisdiction over such things as the manner in which coal mines are to be operated, safety measures to be observed, all matters concerning labour such as wages, hours of work, labour welfare and the settlement of labour disputes, and marketing practices and prices insofar as sales within the province are concerned. It also includes, in the case of provincial lands, authority over the granting of coal leases and the royalties and rentals to be paid thereunder. This section also gives the provinces exclusive authority to make laws in relation to "direct taxation within the province in order to the raising of a revenue for provincial purposes".

Section 91, delimiting the legislative field of the Dominion Parliament, gives that body exclusive legislative jurisdiction over all matters not assigned specifically to the provinces, general power to raise money by "any mode or system of taxation" and authority over "the regulation of trade and commerce". In addition, Parliament is given jurisdiction over "Militia, Military and Naval Service and Defence" and is authorized to make laws generally for "the peace, order and good government of Canada". These latter powers, singly or in combination, have been interpreted to give Parliament in times of emergency the right to override the legislative authority of the provinces in the fields specifically assigned to them. This authority will be dealt with more fully when we come to consider the activities of the Dominion Government in relation to coal during the two World Wars.

In the light of this brief review, it is evident that any planning for the coal industry by the Dominion Government must take into account the powers and policies of the governments of the several coal-producing provinces.

PROVINCIAL GOVERNMENTS IN RELATION TO COAL

The Ownership and Control of Coal Lands and Revenue from Coal

The ownership of coal rights in the provinces is reviewed in the chapter on Coal Reserves. In Nova Scotia and New Brunswick the mineral rights are vested in the provinces and the operators pay a tonnage royalty on the coal mined. In Alberta and Saskatchewan the ownership of coal lands was vested in the Dominion until 1930, when as of October 1 in that year it was transferred to the provinces by Chapters 3 and 41, respectively, of 20-21 Geo. V. During the period of Dominion Government control, ownership of a very considerable percentage of the western coal lands passed into the hands of private owners, generally free of royalty but sometimes with a royalty reserved to the Crown, but the policy of the governments of these provinces throughout has been to retain ownership and permit mining to be carried out by private operations under lease or licence on a royalty basis or on the basis of a rental coupled with a royalty. In British Columbia substantially all of the coal lands in the areas in which they operate are owned by the operating companies, but new areas opening up will be operated under leases or licences granted by the Province under the Coal Act (1944 B.C. c. 26).

The ownership of the coal lands provides the provinces with a means of effecting a practical control of coal mine operations through licensing, leasing and forfeiture procedure, the leases themselves and the coal mining laws of the provinces generally laying down rules under which mining operations may be conducted. The provincial governments derive substantial revenue from royalties, rentals, licence and other fees, taxes on production, and in the case of alienated mineral rights, taxes on the coal lands themselves.

Royalties vary considerably from province to province. Nova Scotia charges a royalty of 12.5 cents per long ton and a rental of $30.00 per square mile, rental payments being credited against the royalty liability. In New Brunswick a royalty of 9 cents per short ton and a rental of $10.00 for each 40 acres are charged, the rental there also applying against the royalty. Saskatchewan and Alberta each charge a rental of $1.00 per acre on leases of Crown coal lands and, in addition, charge a royalty of 5 cents per short ton on the coal produced, save where coal lands have been sold subject to royalty, in which case the royalty is 7 cents per ton. In British Columbia, where operations are conducted on Crown lands, a rental of $1.00 per acre plus a royalty of 25 cents per ton is imposed.

In Nova Scotia and New Brunswick there are no alienated coal lands, consequently no coal lands tax; nor does there appear to be any tax on coal production. British Columbia has had for many years a tax of 10 cents per long ton payable by the occupant of coal lands, whether owner or lessee, on all coal produced and sold, except coal on which royalty is payable and except coal used in the province for coking, in which case the owner of the coke ovens pays a tax of 10 cents per ton on the resultant coke. In both cases the tax is alternative to the provincial income tax, the tax-payer paying whichever is the greater. In addition, the owner pays a tax on the assessed value of coal lands of 1 per cent where mining is conducted thereon and 2 per cent on non-producing lands. The former tax has meant an average revenue over the past 10 years of about $130,000 per year, and the latter an average of approximately $34,000. In 1938 Alberta embarked on a policy of mineral taxation, followed by Saskatchewan in 1944. Both provinces now impose a tax on all privately held mineral rights, the former of 1.5 cents per acre (though the executive has the authority to increase this to 5 cents) and Saskatchewan of 3 cents per acre. Both governments are also empowered to impose an additional tax; in Alberta up to 10 mills on the assessed value of the minerals where the lands are located in a

"producing area"; in Saskatchewan producing lands are taxed on the same basis, but on non-producing lands in producing areas the added tax is 50 cents per acre. It is assumed that both provinces in enacting this legislation had in mind the forfeiture of unexploited mineral lands for non-payment of tax as well as the revenue possibilities, though in Alberta the coal rights in some 15.75 million acres have been alienated so the revenue possibilities are substantial even though up to date the receipts are unimportant. In Saskatchewan no assessments of coal lands have been made up to the present, but the acreage tax produced in its first year about $25,000.

The revenues received by the coal-producing provinces in recent years, derived from royalties, rentals and taxes, are as follows:

Year	Nova Scotia	New Brunswick	Saskatchewan	Alberta	British Columbia
	$	$	$	$	$
1935	716,334.37	29,369.00	26,006.94	329,610.95	153,124.64
1936	671,495.75	32,337.00	23,047.97	315,162.94	156,559.81
1937	730,333.50	36,639.00	25,845.63	293,194.97	153,277.18
1938	657,286.62	26,068.00	20,966.28	263,772.26	152,249.13
1939	692,834.87	38,275.00	19,243.53	292,803.05	207,488.64
1940	809,101.85	51,905.00	26,622.26	305,524.69	192,494.95
1941	758,070.03	47,761.00	23,240.74	324,458.09	213,514.85
1942	751,104.06	43,948.00	20,684.38	344,343.99	216,877.57
1943	623,250.28	44,160.00	27,758.38	352,684.81	209,567.00
1944	602,685.21	36,259.26	23,267.48	391,431.28	210,836.75

It should be noted, in using the above figures for the purpose of comparison, that in the case of all provinces but British Columbia the figures include little or no money received from taxation, while the British Columbia revenues are practically all derived from the two forms of taxation referred to above.

Provincial Control of Mining, Miners' Qualifications, and Labour Welfare

In all provinces where coal is produced statutes or regulations dealing with the operation of coal mines are in effect. The provincial departments provide mine inspectors and staffs to administer this legislation, and their activities relate to such matters as the opening or closing of mines, mine rescue work and the administration of safety regulations, the keeping of statistics, the preparation of monthly and annual reports pertaining to all phases of production, the administration of mine boundaries and conservation methods, and the administration of regulations concerning installation of electrical and other machinery. The provinces also hold examinations and issue certificates of proficiency to coal miners, managers and engineers. The general departmental expenditure of the provincial governments in relation to these matters in recent years is as follows:

Year	Nova Scotia	New Brunswick	Saskatchewan	Alberta	British Columbia
	$	$	$	$	$
1935	103,567.27	7,351.00	17,816.47	35,455.47	25,697.04
1936	90,003.73	7,711.00	17,643.02	34,609.37	27,862.34
1937	107,739.59	8,082.00	15,469.40	38,417.88	31,150.27
1938	121,251.50	8,402.00	8,811.78	37,711.57	32,837.05
1939	126,331.11	8,023.00	18,985.21	42,201.73	31,236.22
1940	146,677.20	7,914.00	15,461.76	37,624.13	30,931.99
1941	126,273.75	8,038.00	10,342 21	38,671.13	29,589.60
1942	137,264.57	8,643.00	10,460.71	39,638.71	29,168.45
1943	165,237.76	11,289.00	10,962.22	42,522.74	30,935.20
1944	184,025.21	11,740.00	10,195.94	41,414.41	35,328.83

These figures again require some adjustment before being used for the purpose of comparison, inasmuch as the Nova Scotia figures include an average of about $28,000 per year paid by the Government of Nova Scotia by way of miners' relief and grants to societies to supplement Workmen's Compensation, and to take care of cases where Workmen's Compensation was not payable. In addition, in some of the provinces where coal mining is only one of many matters handled by the provincial department in question the salaries of the senior officials of the department have not been included, while in other cases they have.

Each of the provinces has also some form of Workmen's Compensation to cover accidents in the mining industry as well as other industries, the compensation generally being paid by the province to the injured workman (or, where death has occurred, to his dependents) out of assessments against employers.

Statutes passed in exercise of provincial jurisdiction over wages, hours of work, child labour, and labour disputes, relate to all employment and are touched upon in the chapter entitled Industrial Relations. Those dealing with wages and hours of work are, in any event, of no particular importance here, as they fix minimum standards which are below those prevailing in the mining industry.

As municipal affairs are primarily of provincial concern, the provinces have sometimes been called upon to assume liabilities of substantial proportions to maintain coal mining communities. For example, the Province of Nova Scotia found it necessary in 1935 to assume financial responsibility for the Inverness coal mines. In this venture, to the end of 1944 the Province had expended $1,633,214.50 to cover operating deficits and $402,747.46 for capital construction.

Marketing of Coal

Since 1941 the marketing of coal has been carried out under the jurisdiction of the Dominion Government, prices being fixed by the Wartime Prices and Trade Board and the distribution of coal being under the direction of the Coal Controller. Prior to World War II, however, the provinces rendered assistance to the producers in dealing with their marketing problems. In 1920 Alberta established a coal sales publicity office in Winnipeg. The work of this office assisted in the replacement of American anthracite by Alberta coal and substantially increased sales in that industrial and commercial market. Alberta Trade Commissioners in Ottawa and Toronto have attempted to promote sales in Ontario. Alberta also enacted in 1925 a Coal Sales Act (1925 Alta. c. 21) to standardize the grades of coal placed on the market. In Saskatchewan, following hearings before the Turgeon Coal Commission of 1934, the Province enacted the Coal Mining Industry Act (1934-35 Sask. c. 73). Under this Act rules of fair competition, including a minimum price structure and a minimum wage scale and code of ethics, were established. In British Columbia, a Coal Sales Act (1931 B.C. c. 38) is administered by the mines inspectors covering the grading of coal and the use of brand names.

Geology and Research

In geology and research work the provincial governments have relied principally on the Federal Department of Mines; however, most of them have made some independent geological surveys. New Brunswick has done no research work and its geological work has consisted of hand drilling, diamond drilling, surveying, and the preparation of plans. Nova Scotia has also confined its geological work to a certain amount of diamond drilling and a few summer field parties. It established an Advisory Board on Fuel Investigation in 1928, consisting of representatives of the Provincial and Dominion Governments, the Nova Scotia Technical College, the Canadian National and Canadian Pacific

Railway Companies, and the coal operators. This Board investigated the properties of Nova Scotia coals. Boiler trials, economy tests and chemical analysis work have been carried out at the Nova Scotia Technical College and St. Francis Xavier University. Saskatchewan has done very little in the way of geological work, and its provincial research effort has been directed towards the development of the use of lignite. This work commenced in 1912. In 1918, in conjunction with the Dominion Government and for a time the Province of Manitoba, experimental work on the carbonization of lignite was carried out by the Lignite Utilization Board of Canada, which will be dealt with later in this chapter. Saskatchewan's share of the costs of this Board was $267,500. Since the Board concluded its activities in 1924, the Province has continued to foster the use of Saskatchewan lignite. In addition to the cost of the Lignite Utilization Board, the Province has expended about $72,500 on research.

The Province of Alberta has made a number of detailed surveys of the coal deposits of the Province, most of which were made prior to 1928; one important survey commenced in 1945 and is still continuing. Most of this was done under the direction of the Alberta Research Council, which was established in 1919. Until 1933 this Council was financed by direct legislative grant. For ten years (1933–1943) the work of the Council proceeded on a reduced scale as an activity of the Government-financed University of Alberta. Since 1943 the Province has again financed directly the work of the Council.

The Alberta Research Council has also conducted extensive investigations on the characteristics of coal, with particular reference to classification, preparation, processing, use in domestic heating equipment and automatic stokers. The Council has also conducted boiler trials on various coals. It has published a number of pamphlets, of which the most important is perhaps Report No. 35 published in 1944 entitled "Coals of Alberta". From 1923, the earliest date for which accurate financial records are available, to the end of 1946, the Alberta Research Council will have expended approximately $336,200 on fuel research and approximately $73,350 for geological work.

Under the terms of British Columbia's entrance into Confederation the Government of Canada undertook to do certain geological work, and as a consequence (at least until very recently), no such work was done by the Province directly; nor, apparently, has the Province done any extensive work in the matter of fuel research.

Several of the provinces have on various occasions appointed Royal Commissions to investigate certain aspects of the coal industry. Among these are the Duncan Commission of 1925 in Nova Scotia, which dealt specifically with labour problems but made recommendations respecting the establishing of coking plants; the Turgeon Commission of 1934 in Saskatchewan; the Barlow Commission in Alberta, appointed in 1935; and the Macdonald Commission in British Columbia appointed in 1934.

ACTIVITIES OF THE GOVERNMENT OF CANADA

Geological Survey and the Mines Branch

The Geological Survey is one of Canada's oldest public services, having been founded in 1843 under Sir William E. Logan. Logan was appointed on the recommendation of the Geological Survey of Great Britain. Originally the Survey was financed by the British Government but it was subsequently taken over by Canada.

At the time when the Geological Survey was founded, Canada was mostly a wilderness which remained to be explored, and the work of the Survey was to map the country and to make its potentialities known. Perhaps two-thirds of the hundred years which have elapsed since Logan commenced his work were

occupied in preparing sketch maps of half a continent on which our colonization and mining enterprise have been based. In addition, certain sections of the country were more intensively mapped but it will require many more generations before all the details will be filled in.

Orginally the Survey was the only government institution engaged in exploration and investigation of the natural resources of Canada, but in course of time its work has become more exclusively concerned with the mining industry. At the present time all the provinces maintain departments of mines or similar organizations, and the Geological Survey consults with the provincial authorities before commencing field work. The results of all operations are made available to interested parties and to the public.

The Geological Survey commenced its work in the coal fields of Nova Scotia before Confederation. In 1873 work was commenced on geological maps of the coal fields of Nova Scotia, and the scientific basis for the development of the Nova Scotia coal mining industry is the information compiled at that time.

The Geological Survey had a party mapping the coal fields on Vancouver Island before British Columbia became a province. One of the conditions under which British Columbia joined the Union was that the Dominion would continue geological survey work in that Province.

In western Canada the work of the Geological Survey followed the construction of the railways. Exploration parties surveyed and mapped the coal fields of Saskatchewan, Alberta, and the mainland portions of British Columbia in the vicinity of the areas served by the railways. By 1907 the preliminary exploration work of the Geological Survey was virtually complete in these areas. While exploration work was proceeding in western Canada, more detailed information was being compiled regarding the coal fields of Nova Scotia.

In 1907 the Dominion established the Department of Mines to take over and expand the work of the Geological Survey. The Department, as created, consisted of two branches—the Geological Survey and the Mines Branch. The Geological Survey branch continued the detailed work in relation to the coal fields. By 1913 sufficient data had been assembled to permit an estimate of the coal resources of Canada to be presented to the twelth International Geological Congress at Toronto.

Detailed geological surveys of the coal measures and associated strata were continued until about 1934. Maps and reports were prepared, as well as coloured plans of many coal fields, for the use of the operators and engineers. While these detailed surveys do not make as interesting historical reading as the original reconnaissance surveys with their spectacular discoveries, the detailed work was a natural sequence to the earlier work and was necessary to make the work of the Geological Survey of practical importance. By 1934, lack of markets was making it difficult for operators to dispose of their potential output and, in consequence, the exploratory work of the Survey was considerably curtailed. Most survey parties were withdrawn from the field, and such work as has been carried out since was done to assist existing mines.

While it is impossible to segregate amounts spent for geological survey work on coal from work done with respect to other minerals, departmental officials estimate that during the 1920's approximately $50,000 per year was spent on coal surveys, decreasing to about $30,000 per year during the 1930's and about $20,000 per year since.

At the present time the Geological Survey has one party operating on Vancouver Island under the direction of a resident geologist. In addition, there is one party operating in the coal fields of Nova Scotia.

When the Department of Mines was formed in 1907 provision was made for a Mines Branch, in addition to the Geological Survey. A Fuels Division of this branch was established and equipped to provide research facilities for

the productive side of the industry to the end that all requisite technical data would be available concerning Canadian coals. A small experimental station, primarily built for work on peat, gradually increased its scope and became the Fuel Testing Station from which the present Fuel Research Laboratories have developed. The Fuels Division has continuously conducted both field and laboratory investigations and major investigations, including physical and chemical surveys, have been made to ascertain the characteristics and suitability of Canadian coals for different uses. Special tests have been made as to burning efficiency and coking potentialities. Experiments which have been carried out relate to separation, washing, sizing and blending of coals, and the effects of storage. Samples tested sometimes exceed one thousand per year. Active co-operation with United States authorities has provided an international coal classification scheme. The Division has been active in research work on Nova Scotia coal, with a view to extending its use in central Canada both for industrial purposes and (when converted into coke) as a substitute for imported anthracite. Hydrogenation investigations have indicated that various Canadian coals may be suitable for conversion to petroleum products. All information obtained by investigation is made available in reports, pamphlets and other publications.

During World War II large scale investigations had to be discontinued as staff was loaned to other departments for work on war purchasing and special wartime projects. Prior to the war the Division of Fuels was expending approximately $19,500 per year for salaries, administration and materials on coal research. Equipment in use was valued at about $130,000.

Lignite Utilization Board

One of the results of the fuel shortage in 1917 was the appointment of a Fuel Committee to study the western lignite problem. This Committee recommended that a commercial demonstration be made of a process of utilizing lignite for domestic use by carbonization and briquetting. By P.C. 643 of March 20, 1918, and an agreement made thereunder, the Lignite Utilization Board was established, the Dominion undertaking one-half and the Provinces of Manitoba and Saskatchewan one-quarter each of the cost of a commercial plant to be built in the Souris district in Saskatchewan. The plant was built under an agreement with Western Dominion Collieries Limited, which owned the surface and mineral rights on the plant location. The plant was completed in the fall of 1921, but the process did not appear to be commercially successful and the plant was closed down early in 1923. In March, 1924, the Board reported in detail its operations and the results secured, and stated that a technical process had been completely demonstrated but it was not the process for which the plant had been originally designed and conversion of the plant to the new process would require a very large additional expenditure of capital. In 1927 the plant was disposed of to the company on whose property it was built. Since that time it has changed hands again and, as this is written, is operating successfully. The total cost of the Lignite Utilization Board was $1,037,225.95, of which the Dominion contributed $534,215.05, Saskatchewan $267,105.53, and Manitoba $235,903.37, Manitoba having withdrawn before the Board concluded its work.

Peat

In the absence of commercial coal resources and in view of the extensive use made of peat in Europe, it is natural that considerable attention has been given in Ontario and Quebec to the possibility of using the peat deposits of those provinces. In 1864 a plant for the manufacture of peat fuel was established at Bulstrade, Quebec. From then until 1910 it is known that over forty enterprises

were started to utilize peat, but all ended in failure. In 1908 the Dominion undertook to investigate thoroughly the peat resources of Canada, and two years later the Department of Mines sent representatives abroad to study the European methods of preparing peat fuel. As a result of enquiries, a small plant was imported from Sweden and installed at Alfred, Ontario. After several years of experimental work, an enlarged plant was erected and commercial operations commenced in 1914. Owing to the outbreak of war, operations were suspended.

In 1918 a critical fuel shortage had developed and, in conjunction with the Ontario Government, the Dominion appointed a Peat Committee to resume the study of peat fuel production with a view to finding a practical method capable of commercial operation on a large scale. This Committee carried on exhaustive investigations over a period of about five years at a cost in the vicinity of $350,000, borne equally by the Dominion and Ontario. An operating plant was constructed at Alfred, Ontario. The Committee finally reported that the manufacture of peat fuel could be carried out successfully but its market was limited to areas within a short distance of the plant, and the Government took the position that private capital should continue the development. Private attempts to develop the enterprise at Alfred failed, and after a further expenditure of about $150,000 by the Dominion the project was finally abandoned in the autumn of 1929.

Government Control during World War I

The supply of coal prior to the war had not been a problem. Even the early years of the first Great War did not change this situation, but as industry in both Canada and the United States expanded, due to war requirements, a coal shortage developed during the winter of 1916-17, and prices moved upwards. At the same time Canada's production had been falling, due, largely, to the loss of men from the mines to the ranks of the Army. In Nova Scotia alone, in the early days of the war 6,000 experienced miners volunteered for service. Differences between operators and employees were also occurring, largely due to the increase in cost of living, and this contributed to the decrease in production.

The first positive step taken by the Dominion Government in the control of the coal industry was the appointment by P.C. 1725 on June 25, 1917, of W. H. Armstrong as Director of Coal Operations in the Alberta and eastern British Columbia field. He was given authority over the management and operation of coal mines in that district, and was given authority also to control wages and fix the price of coal at the mines. It was found, however, that this was not sufficient, and on July 12, 1917, by P.C. 1887 a Fuel Controller was appointed, his principal responsibilities as set out in the Order in Council being as follows:

(1) To examine the coal situation in Canada as to the probable demand, the output of Canadian coal that could be relied on, and to ascertain what measures might be adopted to increase the output; to investigate the outside sources of coal; and the possibility of providing transport of both Canadian and foreign coal.

(2) To confer with and co-ordinate the different interests involved, with a view to ensuring as far as possible a sufficient supply of coal.

(3) To make regulations, for the approval of the Governor General in Council, governing the price of coal, wood, and gas, and the production, distribution, sale, delivery, consumption, and use thereof.

All of the authority conferred on both the Director of Coal Operations and the Fuel Controller was derived from the War Measures Act of 1914 (5 Geo. V. c. 2), which was enacted under the "peace, order and good government" clause of the British North America Act and which statute gave the Governor General in Council power "to make such orders and regulations as

might be deemed necessary by reason of the existence of real or apprehended war, invasion or insurrection, or advisable for the security, defence, peace, order, and welfare of Canada".

The Fuel Controller's immediate objectives were—first, to secure equitable distribution of available coal supplies to meet householders' requirements across Canada, a matter which was made more difficult by the redistribution of the population due to the establishment of war industries; and second, the maintaining and increasing, if possible, of coal shipments from the United States. It was decided that the first problem could be met best by making use of provincial and municipal machinery, and as a consequence each province in the early summer of 1917 appointed an administrator to work in co-operation with the Fuel Controller. Coal regulations were made empowering any municipality to appoint a local Fuel Commissioner or Board of Commissioners for the purpose of watching local supplies and requirements and developing teamwork amongst dealers, and giving such Commissioner or Board of Commissioners, if appointed, power to pool stocks of coal, to ration consumers, to requisition delivery equipment, and to insist on partial use of coal substitutes where available. On the second problem the Fuel Controller worked in close co-operation with the United States Fuel Administration and was generally successful in increasing deliveries of American coal, in spite of a greatly increased demand in the United States.

In the realm of price control, the Fuel Controller proceeded by licensing importers whose licence fees accrued to the Dominion, and by licensing dealers whose licence fees were paid to the provinces. He also fixed coal prices at the mines and fixed a maximum profit of 30 cents per ton to brokers, 35 cents per ton plus the cost of handling to the wholesaler, and 50 cents per ton net profit to retailers. To make this control effective, he also issued regulations dealing with the calculation of costs, excluding all items of capital, income and business profits taxes, and interest on borrowed money or on money invested in land, plant or equipment.

The Fuel Controller was also active in the sphere of conservation by a program of information designed to make the best possible use of the available coal. He also brought about the periodical closing of places of amusement and, in co-operation with the Canadian Railway War Board, was able by such measures as heavier loading of railway cars, elimination of duplicate train services and careful routing of transportation, to save an estimated one million tons of coal on the Canadian railways during the year 1918.

On the completion of his work at the end of March, 1919, the Fuel Controller, C. A. Magrath, made a complete report to the Minister of Trade and Commerce. This report, which was published, reviewed the activities of Fuel Control during World War I and dealt in considerable detail with fuel problems in Canada.

The Dominion Fuel Board—The Period between the Wars

Following the conclusion of the first Great War, the consumption of coal (which had reached a total of 34,800,000 tons) fell off rapidly due to the cessation of munition production, the decline being largely in imported coal. Coal supply was not a serious problem and no great attention seems to have been paid to the subject, save for continued activity in research by the Department of Mines, until 1921 when a Special Committee of the House of Commons was set up to deal with the fuel resources of Canada, the production of Canadian coal, the importation of coal, the transportation of same, and the development and utilization of other sources of energy. The report of the Committee recommended the appointment of an officer to keep in close touch with the fuel situation, clothed with powers to cope with any emergency that might arise and authorized

to examine all phases of the fuel situation. The Committee also urged the development of water resources, the electrification of railways, the reduction of water transport rates, and the wider use of Canadian coal and peat instead of imported anthracite, with a campaign of publicity in that direction.

Following the report of this Committee and influenced no doubt, by the extended strike in the United States coal fields in 1922, the Minister of Mines in a report dated November 8, 1922, after outlining the problem and reviewing the work done up to that time by the Department of Mines and the provinces, recommended the organization of the Dominion Fuel Board to be composed of government officials already connected with the investigation of fuels and to be given authority to carry out more fully the recommendations of the House Committee and of the Magrath report. This Board, under the chairmanship of Dr. Charles Camsell, Deputy Minister of Mines, was established by P.C. 2381 on November 25, 1922. Specifically, the Board was instructed to study Canada's fuel problems "in view of the ultimate necessity of substituting other fuels for anthracite coal for domestic heating purposes in Central Canada".

During the winter of 1922-23 the United States Fuel Control Board had been unable to give Canada the usual supply of anthracite, and there was a severe shortage of domestic fuel. The Dominion Fuel Board warned that Canada could not hope in the future to get the usual supply of anthracite from the United States.

On March 8, 1923, a Special Committee of the Senate was appointed to consider the Canadian fuel supply, its most efficient use, and whether the Committee could assist the Dominion Fuel Board. It recommended that the Board be empowered to co-operate with the transportation and other interests, to the end that freight rates might be reduced and better facilities provided for the handling and storing of coal. It recommended also that the public be informed as to the need for using Canadian coal and the advantages of obtaining supplies during the summer season when transporting and mining facilities were capable of supplying requirements. The Committee urged that the Board be given fullest powers and sufficient funds to prosecute to the full its investigation into the use of Canadian coal and to give the widest publicity to the information obtained. It also recommended that the governments interested should consider the advisability of experimenting with the use of peat on a larger scale than theretofore.

On March 19, 1923, a resolution introduced in the House of Commons and referred to the Select Standing Committee on Mines and Minerals stated that, in the opinion of the House, the time had arrived for Canada to have a national policy in relation to its coal supply and that no part of Canada should be left dependent on the United States. The report of the Committee stated "it is absolutely necessary that every step possible should and must be taken at once by Canada, through its government, its transportation companies, its coal operators, and manufacturers of other fuels, to make Canada independent of other countries for its fuel supply".

The Committee urged the calling of a conference of coal operators, representatives of transportation companies, and representatives of the various provincial governments and the Federal Government, to deal with the fuel situation, and that the Government undertake an independent investigation to ascertain the actual cost of carrying coal from eastern and western points to Central Canada. The Committee urged further investigation into the development of peat and also reported on the value of coke as a domestic fuel, and remarked that coking plants in the large centres of Canada might assist in solving the domestic fuel supply.

The Dominion Fuel Board on May 21, 1923, issued an Interim Report. It recommended, amongst other things, investigation of the possibility of utilizing Nova Scotia bituminous coal in the making of domestic coke and the

establishing of by-product recovery coking plants in the large centres of population, and further study of the transportation of Alberta coal into Central Canada.

Parliament, on March 31, 1924, adopted a resolution reiterating the necessity of making Canada independent of the United States for its coal supply and providing that "the Government should immediately consider the institution of an all British and Canadian coal supply and that such a policy is both a social and economic necessity and in the best interests of the future of Canada".

As a result of these investigations, reports and resolutions, assistance was given for the first time to the westward movement of Nova Scotia coal. By P.C. 1537 on September 3, 1924, the sum of $200,000 was voted and its expenditure authorized for this purpose. This Government assistance to the movement of coal, which was greatly expanded from 1928 on, is set forth in detail in the chapter of the report on Subventions and Other Aid. A further result of these reports was Tariff Memorandum No. 50 of May 14, 1925, which permitted a drawback of 99 per cent on bituminous coal when imported by proprietors of by-product recovery coke ovens and converted by such ovens into coke, the drawback not applying on coal converted at a gas retort plant. The same Memorandum levelled the tariff rates on bituminous coal. The history of tariff changes concerning coal is told elsewhere in this report.

On March 15, 1926, a Special Committee of the House of Commons was appointed to investigate the coal resources of Canada, and its report recommended trial shipments of Alberta "domestic" coal under the supervision of the Fuel Board by rail and lake to central Canada, to ascertain the possibilities of moving such coal in large volumes with modern loading and unloading facilities. It also recommended the enactment of legislation to encourage the production of domestic coke, co-operation with the provinces in establishing standards of quality and regulations governing the shipment and marketing of coal and coke, that some assistance be given to encourage the enlargement of markets for Maritime coal, that the duty on bituminous slack coal of 50 cents per ton be extended to anthracite small coal, and that the exemption from duty on foreign coal for bunkering ocean-going ships be withdrawn. It also recommended that coal handling facilities at Montreal, Toronto and Hamilton be improved, and that study be given by the Canadian National Railways to the possibility of materially increasing the average freight train-load, reducing the cost of the rail haul from Alberta to the Head-of-the-Lakes. This Committee also suggested that the Government might consider the renewal of the vote made in September 1924 to assist the rail movement of Canadian coal.

A few days after the appointment of this Committee a Royal Commission was appointed (by P.C. 505 on April 7, 1926) to investigate the grievances of the Maritime Provinces. Its report supported the recommendation of the Special Parliamentary Committee of 1926 that early consideration be given to the renewal of the subvention made in 1924 and payable to the railway companies, conditional on a reduction of the then existing rates for coal carriage. This Commission also recommended that practical steps be taken by the Federal authorities to encourage the building of plants for the coking of Canadian coal, and asked the Tariff Advisory Board to consider the question of the customs tariff on coal and coke.

A second report of the Dominion Fuel Board published in 1928 reviewed all of the activities of the Board up to that point and made a number of suggestions with respect to the problem of developing a Canadian fuel supply and of the utilization of fuels.

The results of these Committees and Commissions and the activities of the Dominion Fuel Board were threefold. Tariff changes were made and subventions on the movement of coal from East and West to central Canada were instituted and continued, as set out in detail in the chapter on Subventions and Other Aid.

Assistance was also given to the coking of Canadian coal by the Domestic Fuel Act (17 Geo. V. c. 52) which subsidized the building of several by-product coking plants, subject to the use of Canadian coal; P.C. 944 of April 26, 1932, and other Orders in Council which assisted the movement of Canadian coal for coking, to the extent of the difference in laid-down cost to the coke manufacturer; and the Act 20-21 Geo. V. c. 6 assented to on May 30, 1930, and hereinafter referred to as the Coke Bounties Act, which granted a bonus equivalent to the then existing tariff drawback on imported coal to persons using Canadian coal converted into coke for the smelting of iron. These Acts and Orders in Council are dealt with in detail in the chapters entitled Products and By-Products and Subventions and Other Aid.

During the remainder of the period prior to World War II Government activities were largely confined to these forms of aid, all of which were administered by the Dominion Fuel Board, and to continued activity in fuel testing and geological research by the Department of Mines and Resources. The Dominion Fuel Board throughout co-ordinated all Dominion Government activities with respect to coal. This period, including as it did some of the worst years of the depression, was marked by falling coal consumption and the offering of foreign coals at depressed prices. While this Board came into existence as a result of an expected coal shortage, its principal function soon became that of administering subventions for the purpose of assisting the Canadian producer to find markets for the coal that was produced. Its annual administration costs averaged approximately $25,000.

Coal Control during and since World War II

As the position presently accupied by the Government of Canada in relation to the coal industry is based almost entirely on the overall control of the Canadian economy that was gradually developed during the war years, an understanding of this system of control in all its branches (and the reasons requiring it) is essential to an appreciation of the steps taken in relation to the coal industry during the war and the controls which are presently in effect.

The proclamation of war in September 1939 automatically revived the War Measures Act which had formed the legal basis for such controls as were instituted during World War I and which remained on the statute books as R.S.C. 1927 c. 206. It was recognized, however, that the probable requirements of highly mechanized warfare and the weaknesses that had become apparent in controls exercised during the last war required a much more rigid supervision of the economic life of the country, if Canada's part in this war should be fully effective.

The principal objects to be attained were two: first, the supply and proper distribution of materials essential to the successful prosecution of the war and, second, the equitable distribution at reasonable prices of essential civilian goods in short supply. It was important, in order that these objectives should be attained with the least possible adverse effect on the national economy, that inflation be avoided, and, as considerable buying of war supplies in the United States was inevitable, that non-essential purchases in that country be curtailed.

During the period of the war this involved the control and conservation of foreign exchange, the control of prices, control of wages and salaries, the rationing of civilian goods and a system of priorities concerning goods essential to the war effort, measures designed to make the most effective use of available manpower, taxing measures to meet the cost of war and to control inflation, and measures designed to maintain and increase the production of essential commodities.

As these controls were a gradual development during the earlier years of the war, it is proposed to deal chronologically with the principal steps taken, with particular reference to the measures giving jurisdiction over the coal

industry. We have attempted in this history to deal only with the more important enactments and orders; it is not complete but does, we believe, give the minimum background necessary to an understanding of what was done. Steps actually taken in relation to the coal industry in execution of such authority will be dealt with later.

(*a*) Chronological Development of General Controls

1939—War Commences; Coal Administration Established

Parliament was summoned immediately on the outbreak of war and promptly enacted the Department of Munitions and Supply Act (3 Geo. VI c. 3), which Act established the department of that name, and to supplement the powers of the executive derived from the War Measures Act gave its Minister power to mobilize, conserve and co-ordinate the economic and industrial facilities available in respect of munitions, supplies and defence projects. He was given power to purchase and acquire munitions, to give priority to certain work, and to appoint persons to control such industries. This Act was proclaimed April 9, 1940. At first enacted for three years only, this limitation was removed in 1943 by 7 Geo. VI c. 8.

At the same session, by 3 Geo. VI c. 6, the Income Tax Act was amended, increasing the tax on corporation income from 15 per cent to 18 per cent, and, by 3 Geo. VI. c. 4, the Excess Profits Tax Act was enacted, imposing an additional tax of 50 per cent on profits in excess of those of the "standard period", meaning the average profits of the years 1936 to 1939 inclusive.

Under the War Measures Act meanwhile, by P.C. 2483 on the third day of September, 1939, the Defence of Canada regulations were issued, delegating to various departments and officials wide powers over persons and properties, and on the same day (by P.C. 2516) the Wartime Prices and Trade Board was established under the Department of Labour with power to fix minimum prices and margins of profit for necessaries, to investigate costs, to take possession of supplies unreasonably withheld from the market, to ration purchases and sales, and to license persons producing or dealing in necessaries and to compel them to provide full details of their operations to the Board. On September 14 a memorandum was drawn up by the Secretary of the Dominion Fuel Board for the Wartime Prices and Trade Board recalling the fuel difficulties of the last war and outlining a programme of action. This resulted in P.C. 3117, October 18, 1939, under which J. McGregor Stewart, K.C., was appointed Coal Administrator "to be responsible in co-operation with the industries and trades concerned, and under the direction of the Board, for the conduct of negotiations with the United Kingdom authorities for the export of coal and other solid fuels to Canada; in co-operation with the provinces concerned for maintaining and stimulating where necessary the production of Canadian coal and other solid fuels; for the supervision of the purchase, shipment, distribution and allocation of coal, coke and other solid fuels, whether domestic or imported, and for such other duties as may be assigned to him by the Board".

Order in Council P.C. 2716 dated September 15, 1939, established the Foreign Exchange Control Board and granted it power to establish rates of exchange on foreign currency. The Board on the same day restricted the export of funds, and for the purpose of permitted transactions fixed the premium payable for United States dollars at 11 per cent.

On November 7 the first step was taken to bring labour disputes, theretofore principally a matter of provincial concern, within the ambit of Dominion jurisdiction. P.C. 3495 directed that the Industrial Disputes Investigation Act (R.S.C. 1927 c. 112) which, except where it had been adopted by provincial legislation, then applied only in the case of industries of an inter-provincial nature, such as railways, should specifically apply in respect of any dispute

between employer and employed on defence projects, or in the case of disputes in concerns engaged in the production or distribution of munitions or supplies. It defined "supplies" to include any commodity which, in the opinion of the Minister of Labour, would be essential for the needs of the Government or of the community in war.

On November 15 a Transport Controller was appointed by P.C. 3677 and authorized to achieve co-ordination of effort in the solution of transportation problems; and on December 20 (by P.C. 4251) the Canada Shipping Board was established and given wide powers over all Canadian shipping, including the responsibility of deciding what materials should be granted shipping space available, and in what order. Both orders were issued under the authority of the War Measures Act, the first being administered by the Department of Transport, the latter by the Department of Trade and Commerce.

1940—First Steps Taken in Manpower Mobilization and Wage Control

At the first session of Parliament in 1940 three statutes were passed having considerable bearing on the control of the Canadian economy. By 4 Geo. VI c. 41, Sec. 11, Section 88-A of the Special War Revenue Act was enacted, imposing a war exchange tax of 10 per cent of the value for duty on all goods imported into Canada, payable by the importer, but excluding goods imported under British tariff or trade agreements with other countries. Sub-section 3 of this section provided that no person should take advantage of the tax imposed by this section to increase the price of goods by an amount greater than justified by any increase in cost properly arising from such tax, and that the Governor in Council might authorize the Wartime Prices and Trade Board to take such steps as might be necessary to prevent such unauthorized increases.

The Excess Profits Tax Act was amended by 4 Geo. VI c. 32 to impose a special tax of 12 per cent on all profits and to increase from 50 per cent to 75 per cent the tax on profits in excess of those earned during the standard period, or such larger "standard profits" in the case of depressed industries as the Board of Referees appointed thereunder might determine.

By 4 Geo. VI c. 13 to grant additional emergency powers, the National Resources Mobilization Act was enacted giving the Governor in Council power to do and authorize such acts and things, and to make such orders and regullations requiring persons to place themselves, their services, and their property at the disposal of the Crown "as might be deemed necessary or expedient for securing the public safety, the defence of Canada, the maintenance of public order or the efficient prosecution of the war, or for maintaining supplies or services essential to the life of the community". This Act was limited in effect "during the continuation of the state of war now existing".

To help conserve American exchange, on April 30 by P.C. 75/2980 authority was granted for the acceptance of export selling prices as the basis for valuation for duty purposes on goods from the United Kingdom.

In the field of labour control, on June 19, 1940, there was established the National Labour Supply Council consisting of employers' and workers' representatives, to advise on matters touching labour supply for industry which might be referred to it by the Minister. On the same day by P.C. 2685 the Government issued a declaration of principles for the regulation of labour, stating that fair and reasonable standards of labour and working conditions should be recognized; that where adjustments were necessary by reason of war conditions they might be in the form of bonus payments; and that established safeguards and regulations for the safety of the workers should not be relaxed. The policy of collective bargaining was affirmed, and it was agreed that each collective agreement should have machinery for the settlement of disputes. It further declared that there should be no interruption of production by reason of strikes or lockouts, and urged that in disputes the assistance of the Government conciliation services should be sought.

Up to this time co-operation between the major agencies within the Department of Munitions and Supply was on an informal basis, but with the increase in war production and the development of shortages it became necessary to closely integrate the efforts of all such agencies. Consequently, by P.C. 2715 of June 24, 1940, the Wartime Industries Control Board was established and Controllers appointed over the major industries involved.

On July 20, 1940, the Coal Administrator's powers were extended by P.C. 3298 to give him authority to purchase and distribute solid fuels and to prescribe the prices to be paid therefor.

The first positive step in the control of the labour situation was the approval of P.C. 6286 on November 7, 1940, which prevented employers from soliciting persons to enter their employment if at the time they were engaged in the manufacture of war equipment or supplies. Earlier that summer the National Registration had provided the Government with a reasonably accurate picture of the special skills possessed by the Canadian people.

During the period since the commencement of the war, living costs had risen about 7 per cent and a corresponding increase in wages was required. As a result, P.C. 7440 was approved on December 16, 1940. It provided that the wage rate level paid by the employer during the period 1926-1929 (or any higher levels established prior to December 16, 1940) should be considered fair and reasonable except where a Board of Conciliation might find such levels to be unduly low. It further provided that a wartime cost of living bonus should be paid, generally of $1.25 per week for each 5 per cent increase in the cost of living according to the Bureau of Statistics cost of living index. This order was not mandatory, but was issued only for the guidance of Boards of Conciliation that might be set up under the Industrial Disputes Investigation Act.

At about this time a further session of Parliament enacted the War Exchange Conservation Act (4-5 Geo. VI, c. 2) which prohibited the importation into Canada of certain goods and removed or reduced the customs duties on certain specified goods when imported from the United Kingdom. By this Act the duty was removed on bituminous coal when so imported. Complementing that enactment, P.C. 7373 of December 13, 1940, gave the Wartime Prices and Trade Board the same powers with respect to goods specified in the schedules to that Act and with respect to persons dealing in such goods as were conferred on the Board under the regulations with respect to the necessaries of life.

By the same session of Parliament (4-5 Geo. VI, c. 115) the Excess Profits Tax of 12 per cent was increased to 22 per cent of total net income apart from the special tax on excess profits.

1941—Wages and Prices Frozen; Import Subsidies Commence

The increasing demands of war production during the year 1941, the gradual development of the manpower shortage and the shortages in essential commodities, were reflected in increased measures of control, and by the end of 1941 the pattern of wartime control of the economic life of Canada was reasonably well established.

Up to that time the Controllers of the Department of Munitions and Supply dealt informally with one another and with the industries involved in the matter of priorities, but as production expanded and as shortages became more serious the Priorities Branch was created by P.C. 1169 on February 20, 1941. Later, on October 31, 1941, the Shipping Priorities Committee was created, and the Shipping Board thereafter allocated shipping space on the basis of the priority ratings given by this Committee, its decisions in turn being based on the recommendations of the Wartime Industries Control Board.

As any work stoppage in the coal mines would threaten the production of essential war materials, the Minister on March 31, 1941, declared coal to be "supplies" within the meaning of P.C. 3495, thereby making the Industrial

Disputes Investigation Act applicable to any dispute. P.C. 4061, approved on June 6, 1941, declared undertakings for the mining of coal to be essential services within the meaning of the Defence of Canada regulations, thereby placing in the civilian authorities power to enforce the regulations prohibiting the doing of any act with intent to impair the efficiency or impede the working of any undertaking engaged in the performance of such services. On the same day (by P.C. 4020) it was ordered that when any strike or lockout occurred or seemed imminent, and whether or not a Board of Conciliation was requested, the Minister of Labour might refer the dispute to a tribunal designated The Industrial Disputes Inquiry Commission to make a preliminary investigation and endeavour to arrive at an adjustment.

About this time it became apparent that the duplication of endeavour by the Coal Administration and the Dominoin Fuel Board was creating administrative difficulties, so on June 25, 1941, by P.C. 27/4600 the duties, functions and establishment of the Dominion Fuel Board were transferred to the Coal Administration for the duration of the war, the Coal Administrator being authorized to administer, under the Wartime Prices and Trade Board, all of the Orders in Council dealing with subventions, the Domestic Fuel Act and the Coke Bounties Act. On August 6 of that year by P.C. 19/6016 the appropriations granted for the purpose of administering these Acts and Orders in Council were transferred from the Minister of Mines and Resources to the Minister of Labour, with power to the latter to transfer to the Wartime Prices and Trade Board all or any of the functions of the Dominion Fuel Board.

On August 14 by P.C. 6332 the Wartime Prices and Trade Board was transferred from the Department of Labour to the Department of Finance, and thereafter the establishment of the Dominion Fuel Board and the Coal Administration were under the jurisdiction of that Department.

It being apparent about this time that the work of the Wartime Prices and Trade Board and the Wartime Industries Control Board should be more closely integrated, P.C. 6834, approved August 28, 1941, issued new Wartime Prices and Trade Board regulations; and P.C. 6835, approved August 29, 1941, issued new Wartime Industries Control Board regulations. Under these, the Chairman of the W.I.C.B. became a member of the Wartime Prices and Trade Board, the Chairman of the Wartime Prices and Trade Board became a member of the Wartime Industries Control Board, and individual Controllers became *pro tem* members of the Wartime Prices and Trade Board when any action affecting their field of control was under discussion. From that time forward the two Boards worked closely together, and in the course of time virtually all of the Controllers were appointed Administrators under the Wartime Prices and Trade Board and all orders issued by the Controllers were required to be approved by the Chairman of the Wartime Prices and Trade Board. Under the new Wartime Industries Control Board regulations, every Controller was given power to fix prices and margins of profit.

The first restriction on the right to strike was imposed on labour by P.C. 7307 on September 16, 1941. It provided that whenever employees desired to strike or take a strike vote they must notify the Minister of Labour of their desire, and if he was of the opinion that a cessation of work would interfere with the efficient prosecution of the war he could direct a strike vote to be taken under the supervision of the Department. Unless a majority of those entitled to vote cast ballots in favour of the strike, it was an offence for an employee to go on strike.

On September 17 the Minister of Finance assigned to the Wartime Prices and Trade Board the power and duty of computing and authorizing payments claimed under the Coke Bounties Act and subventions.

In spite of all attempts to maintain prices at existing levels, wages were gradually moving upward, necessitating increases in commodity prices. Consequently, on October 24, 1941, P.C. 7440 was replaced by the Wartime Wages and Cost of Living Order P.C. 8253, which stabilized all wages at the level in effect on November 15, 1941. This order also established the National War Labour Board and five regional Labour Boards, later increased to nine, of which the chairman was to be in each case a provincial cabinet minister having jurisdiction over labour. The National Board was given authority to increase the basic scale of wages where they were lower than prevailed in the locality and to defer the cost of living bonus where wages were higher than the average. This order maintained the cost of living bonus plan as in P.C. 7440 but was made mandatory on all employers in essential industries, and all employers having fifty or more employees. It was later extended by P.C. 9514 on December 5, 1941, to all industrial employers. As a natural complement to this order, the Wartime Salaries Order (P.C. 9298 of November 27, 1941) stabilized managerial and executive salaries at the levels existing on November 6, 1941. On December 17 the Commissioner of Income Tax was appointed Salaries Controller with power to administer this order.

Up to this point maximum prices had been fixed on very few commodities, the main activities of the Board consisting of efforts to provide an adequate and regular flow of civilian supplies to the Canadian market. But it became apparent that unless rigid measures of control were exercised prices would spiral to dangerous levels. On November 1, therefore, by P.C. 8527 the first Maximum Prices Regulations were established by the Wartime Prices and Trade Board, providing generally that maximum prices for any and all commodities should be the maximum prices in effect during the period from September 15 to October 11, 1941, designated the "basic period"; and that any differences in prices customarily allowed to different classes of buyers, or for different quantities, or under different conditions of sale resulting in a lower net price per unit, should be continued. On the same day by P.C. 8528 the powers of the Wartime Prices and Trade Board were enlarged and a statement of policy was issued, giving an outline of methods by which it was proposed to control prices.

The Wartime Prices and Trade Board Order No. 76 of December 16, 1941, amplified the meaning of "maximum prices" and gave administrators power to specify any price as representing the maximum price under the regulations, to authorize sales at higher levels and to require sales and deliveries at prices that they might determine. This order was later modified on June 30, 1942, but generally speaking the powers of the administrators remained about the same.

About this time it was seen that with rising prices of commodities in foreign countries, particularly in the United States, it would be impossible to hold the general price level in Canada without severe restriction on imports or the granting of subsidies to the importer of foreign goods. It was, therefore, decided to embark on an import subsidy plan, and a preliminary statement was given by the Wartime Prices and Trade Board on December 2 advising that subsidies would be paid on all imported eligible goods, including coal and coke when not used in industry, where prices had risen significantly above the levels obtaining in the basic period. It was decided that the import subsidy and other subsidies which might be instituted should be administered by a separate corporation, and on December 17, 1941, by P.C. 9870, Commodity Prices Stabilization Corporation Limited was incorporated for the purpose of "facilitating under the direction of the Wartime Prices and Trade Board the control of prices of goods, wares and merchandise in Canada", and the Board was authorized to delegate to the company such of the powers of the Board as it might deem advisable.

To help facilitate the importation, under the ceiling, of goods in short supply, P.C. 9888 issued on December 19 suspended, except in respect of fresh fruits and vegetables, the special or dumping duties as provided under Section 6

of the Customs Tariff, and on the same day P.C. 9889 authorized the Minister of National Revenue to accept export selling prices rather than fair market value in the countries of origin as the basis for valuation for duty purposes in respect of goods originating in countries other than the United Kingdom, this principle having been made applicable to British imports since April, 1940.

1942—Selective Service Instituted; E.C.P.B. Established; Excess Profits Taxed at 100 per cent

It became apparent about this time that further restrictions on production would have to be enforced in order to make the best use of available manpower and still maintain price ceilings. This resulted in Order No. 82 of the Wartime Prices and Trade Board dated January 6, 1942, giving each administrator power to prescribe or limit the kinds, qualities, sizes and quantities of any goods that might be manufactured or distributed by any person, and to prohibit manufacture or distribution except in accordance with such limitations.

As a further step in controlling domestic prices, on January 20, 1942, by P.C. 62/450 the Minister of National Revenue directed that under authority granted by the Customs Act import and excise duties and taxes imposed in any country should be disregarded in estimating the value for duty of goods imported into Canada.

The manpower shortage was by this time becoming quite serious, and in March of 1942 several Orders in Council were approved, which together represented a fairly comprehensive policy concerning manpower. A Director of National Selective Service was appointed; provision was made for taking a manpower inventory; a list of restricted occupations was made which no physically fit man of military age could enter without permission; persons engaged in agriculture were prohibited from transferring to other occupations; and arrangements were made for the transfer of technical men to war jobs. In June, Control of Employment Regulations were issued which authorized the Director of National Selective Service to issue orders on the approval of the Minister of Labour, prohibiting the engagement of workers in any specified class except through the local employment office of the Unemployment Insurance Commission.

About this time new Maximum Prices Regulations (P.C. 5109, June 16, 1942) and a new Wartime Wages Control Order (P.C. 5963, July 10, 1942) were issued, but no important changes in the principles governing the preceding orders were made. It might be pointed out, however, that the Wartime Wages Control Order was confined in its operations to persons earning less than $175.00 per month or, if more than that, to persons who were over the rank of foreman or comparable rank. Persons earning over $250.00 per month were deemed to be over the rank of foreman and were subject to the Wartime Salaries Order.

A new order was issued during this summer clarifying and enlarging the powers of the Transport Controller to enable him to exercise full control over all railway equipment. This order (P.C. 4487) was dated June 9, 1942. On July 31, P.C. 6785 similarly enlarged the powers of the Canada Shipping Board.

On August 26, 1942, by P.C. 7595 the National Selective Service Regulations were passed, consolidating all orders concerning manpower which had been made up to date. They gave the Director power to classify occupations according to the degree of essentiality to the war effort, they controlled advertising for employment, provided a seven days' notice for termination of employment, and gave the National Selective Service officers power to direct the acceptance of employment. These were supplemented later in the year by the Labour Exit Permit Order, which required permission to leave the country for the purpose of taking employment elsewhere.

Another important order was issued August 26, 1942, P.C. 7475, outlining the powers of the Commodity Prices Stabilization Corporation, gave the corporation wide power, amongst other things, to investigate costs.

On September 8 (effective November 2) Wartime Prices and Trade Board Order No. 184 took one further step in the over-all control of business by prohibiting the commencement of new businesses, or any change in the type of business carried on, except by permission of the Board.

By a statement of policy dated October 6, 1942, the Wartime Prices and Trade Board amplified its original statement, reiterated the principle of rateable allocation by suppliers of all goods in short supply amongst established customers to whom they sold merchandise in 1941, and pointed out that they had the power to direct any supplier of goods to make delivery of such goods to any designated person. By a further statement on October 21, the Board stated that its objective was that the use of human and material resources in the production of civilian goods should be systematically reduced, and that the Board would proceed by way of control of production, supply and distribution, with the elimination of non-essential lines and the standardization and simplification of existing lines. It also forecast the extension of consumer rationing, and stated that the organization of local ration boards, in co-operation with the municipal authorities, was proceeding.

Towards the end of 1942 it became apparent that with the increased industrial activity and consequent increased coal consumption in both Canada and the United States it would be necessary to take some steps to increase the production of Canadian coal, and on November 23 action was taken by setting up (under P.C. 10674) the Emergency Coal Production Board headed by the Coal Administrator and charged with the responsibility for "taking all such measures as are necessary or expedient for maintaining and stimulating the production of Canadian coal". The subsequent activities of this Board will be dealt with later in this chapter.

Parliament, during this year, took a further step in the control of profits by amending the Excess Profits Tax Act (6 Geo. VI, c. 26) to increase the rate of tax on profits in excess of "standard profits" from 75 per cent to 100 per cent.

1943—Coal Control Established; Employment in Coal Mines Made Compulsory

In January of this year the National Selective Service regulations were consolidated, and all existing Orders in Council dealing with the subject were repealed. The regulations issued by P.C. 246 on January 19, embody in the main, the policy established the previous summer and which existed up to the close of the war with regard to civilian manpower, but are in much greater detail than the earlier order. These regulations directed the Minister of Labour "to take such steps as may be necessary to ensure the efficient use of manpower", though the powers of compulsion vested in him were to be exercised only as a last resort. They were administered through the Director of Selective Service with an Advisory Board consisting of representatives of government departments and labour. Local administration was carried on through National Selective Service officers situated in the Employment and Selective Service offices throughout Canada. Under these regulations, employers who expected a change in labour requirements, or who had more employees than necessary for immediate needs, were obliged to notify the local office. Employment could not normally be terminated by either employer or employee without seven days' notice; permits were required before an employee could seek, be interviewed for, or be offered employment; and permits were required by employer or worker wishing to apply for employees or employment. Selective Service officers could direct any person to accept suitable employment, or request any employed person to change to more important work.

In connection with Coal Administration, it became apparent early in 1943 that the main problem was no longer a matter of price regulation and equitable distribution, but was a problem of supply; accordingly jurisdiction over the production and supply of coal, coke and wood fuel passed from the Wartime

Prices and Trade Board and the Department of Finance into the hands of the Wartime Industries Control Board of the Department of Munitions and Supply on March 5, 1943. P.C. 1752, effecting this transfer, created a new Coal Control which assumed the powers, duties and functions of the Coal Administration, including the functions of the Dominion Fuel Board. Mr. Stewart became Coal Controller, but in the field of price control he remained Coal Administrator under the Wartime Prices and Trade Board. The staffs of Coal Administration and of the Dominion Fuel Board were transferred to the Department of Munitions and Supply. Regulations set forth in this order gave the Controller power to appropriate, produce and deal in, prohibit or regulate any dealing in, and prohibit or ration the consumption of coal, coke and wood fuel. By P.C. 4362 on May 28, Coal Control, which theretofore handled problems of wood fuel as well as coal, was relieved of this responsibility and a new Wood Fuel Control was established.

The supply situation at this time became so important that the Prime Minister declared in the House of Commons a state of national emergency in regard to coal, and on May 17, 1943, P.C. 4092 was passed, providing that no person with two years or more experience in coal mining might remain in any other employment, the men thus released to be returned to the mines by Selective Service. The order also provided that no coal miner could leave his job, nor could a mine operator dismiss a miner without permission from the Selective Service office. Furthermore, no miner could join the Armed Services, either by enlistment or draft, prior to January 1, 1944. It also lowered the age of employment in the coal mines.

In the field of wage control, P.C. 2370 on March 23, 1943, gave the War Labour Boards authority to use a cost of living index earlier than the date of the last pay raise for calculation of the cost of living bonus, where it was necessary to equalize wages paid in a particular industry or locality.

On July 6, 1943, by P.C. 5403, E. J. Brunning was appointed Coal Controller on the resignation of J. McGregor Stewart, K.C.

The fuel supply situation continuing to be critical, in August, 1943, a Director of Conservation was appointed, and Order in Council P.C. 6373 issued on August 11 made it an offence to waste fuel.

On October 1, 1943, P.C. 7002 provided for the appointment of Regional Solid Fuel representatives in each of the provinces with authority to investigate and to keep the Controller informed as to the supply and distribution of solid fuel and the solid fuel requirements in their respective provinces.

The cost of living bonus was merged with the basic wage rates by P.C. 9384 on December 9, 1943, and under that order the War Labour Boards could authorize or direct employers to increase a rate range only to rectify a "gross inequality or gross injustice".

1944.—Wartime Labour Relations Board Established

In 1944 the only new order of particular importance was P.C. 1003 dated February 17, which established the Wartime Labour Relations Board with power over all industries essential to the efficient prosecution of the war, including mining, and all other industries in such provinces as might adopt the order. This order provided for the certification of bargaining representatives, the negotiation of collective agreements, and grievance procedure to be followed, superseding in all these spheres the Industrial Disputes Investigation Act or the equivalent provincial labour legislation in provinces, or with respect to industries, where it was made applicable. The order made slowdowns illegal, and it made strikes illegal pending the election of bargaining representatives and until fourteen days after the conciliation officer appointed by the Board had made a report.

General Position at End of the War

The general position thus established continued until the end of the war. The Wartime Prices and Trade Board, administered by the Department of Finance, had the problem of controlling distribution of civilian goods and of maintaining prices so far as possible at the levels reached during the basic period. This involved in many cases the payment of subsidies, both domestic and import, through Commodity Prices Stabilization Corporation Limited. It also involved, in the case of coal, subsidies on production, administered under the Department of Munitions and Supply by the Emergency Coal Production Board, although these were partly for the purpose of encouraging production. By way of assistance in this direction, adjustments of tariffs and exemption from the war exchange tax were sometimes used. Further assistance in this direction was given by the Wage and Salaries Control Orders, the one administered by the Minister of Labour, the other by the Income Tax Division of the Department of National Revenue, which attempted to keep wages and salaries at the levels attained during the late 1941 levels.

The Wartime Industries Control Board and the various controls administered by the Department of Munitions and Supply were principally concerned with the supply of war materials, but due to the fact that many commodities were common to both military and civilian requirements and that availability of supplies had much to do with the control of prices a considerable amount of overlapping with the functions of the Wartime Prices and Trade Board was inevitable.

With few exceptions, all orders and regulations dealing with prices were issued under authority derived from the War Measures Act; measures dealing with supply were enacted under the Department of Munitions and Supply Act and the War Measures Act; matters dealing with wages and salaries under the War Measures Act; and with manpower under the War Measures Act and the National Emergency Mobilization Act.

Autumn 1946—Economic Controls Still in Effect

Since the close of the war there has been a gradual retrenchment in the entire field of economic control. The Wartime Industries Control Board went out of existence on December 1, 1945, by P.C. 7516 of November 29, as part of this retrenchment policy, and such Controllers as are still operating report direct to the Minister.

For all practical purposes National Selective Service is inoperative, although notice of termination of employment and labour exit permits are still required and some provisions are still in effect for reporting changes in employment. This was a gradual development between May 8 and the end of the year 1945. The order providing for compulsory employment in the coal mines was rescinded December 21, 1945, by P.C. 7430.

The Emergency Coal Production Board was abolished on April 30, 1946, by P.C. 1684, although its principal function (that of subsidizing production under the price ceiling) was transferred to, and as this is written is exercised by, the Commodity Prices Stabilization Corporation.

Price control, while no longer in effect with respect to certain items, still applies to coal and coke, and coal imported for domestic purposes is still subsidized. The War Exchange Tax was repealed by 9-10 Geo. VI, c. 30, effective October 13, 1945, and this, coupled with the return of the Canadian dollar to a position of parity with the United States dollar on July 5, 1946, meant some reduction in the amount required for import subsidies.

Wage and salary controls* are still in effect, although by P.C. 2432 of June 20, 1946, War Labour Boards were relieved from the necessity of applying

* Wage and salaries controls have been discontinued since this was written.

the "gross inequality or gross injustice" principle theretofore in effect, and can now grant increases to the extent that the Board finds that it is just and reasonable that increases should be given.

The War Measures Act, under which most of the wartime controls were instituted, was superseded by the National Emergency Transitional Powers Act (9-10 Geo. VI, c. 25) which was assented to on December 18, 1945. This Act provided for the continuation of the orders and regulations made pursuant to the War Measures Act and gave the Governor in Council power to "authorize such acts and things and to make from time to time such orders and regulations as he may by reason of the continued existence of the national emergency arising out of the war against Germany and Japan deem necessary for the purpose, amongst other things, of facilitating the readjustment of industry and commerce to the requirements of the community in time of peace, and maintaining, controlling, and regulating supplies and services, prices, transportation, the use and occupation of property, rentals, employment, salaries and wages, to ensure economic stability and an orderly transition to conditions of peace". This statute officially declared, for the purposes of the War Measures Act, the end of the war against Germany and Japan, but this declaration does not for other purposes officially terminate the war and does not, therefore, apparently affect the continued validity of the National Resources Mobilization Act or the control provisions of the Department of Munitions and Supply Act. The Emergency Powers Act will expire on December 31, 1946, or, if Parliament does not meet during November or December of that year, on the fifteenth day after Parliament meets in 1947. If it is not re-enacted, extended, or superseded by other legislation, practically all of the price controls and price subsidies will disappear.

The Department of Reconstruction and Supply Act enacted at the same session (9-10 Geo. VI, c. 16) repealed and re-enacted relevant sections of the Department of Munitions and Supply Act, redefining "supplies" to give the Minister virtually the same powers as were exercised in wartime over anything "which in the opinion of the Minister is, or is likely to be, necessary for the needs of the government of the community in war or for reconstruction". Under this Act most of the problems of supply, as distinct from price, might by proper orders and regulations continue to be met, should the Emergency Powers Act not be re-enacted.

(*b*) Activities of Coal Administration and Coal Control

As indicated in the foregoing history of wartime economic controls, the Coal Administrator was appointed shortly after the outbreak of the war as an official of the Wartime Prices and Trade Board. At first responsible to the Minister of Labour and later, through the Board, to the Minister of Finance, his first concern was the equitable distribution of available coal supplies and the maintenance of reasonable prices, and he was granted wide powers to achieve these objectives. The Dominion Fuel Board, previously administered by the Department of Mines and Resources, was transferred to the Wartime Prices and Trade Board and came under his jurisdiction. The progressive increase in coal consumption both in Canada and the United States, and the dependence of war production on coal, eventually made supply rather than distribution or price the important problem. This led first to the establishment on November 23, 1942, of the Emergency Coal Production Board, and the following spring to the transfer of all matters concerning the supply of coal, including the Emergency Coal Production Board, to the Department of Munitions and Supply and to the appointment of the Coal Administrator as Coal Controller and a member of the Wartime Industries Control Board. On April 30, 1946, the Emergency Coal Production Board was wound up, and its function of assisting operators to continue production to enable sale under the ceiling price was exercised thereafter by the Wartime Prices and Trade Board through Commodity Prices Stabilization

Corporation Limited. As problems of supply, distribution and price were so closely related and as Coal Control in many respects simply continued the work begun by the Coal Administrator, it is proposed to deal with their activities together under the various classifications into which their duties fell. Shortly stated, these activities consisted of a continued effort to adjust production and imports to wartime requirements, to maintain a fair and just price within the policies of the Wartime Prices and Trade Board, and to provide equitable distribution of available supply. They might be classified as follows:

(1) Coal distribution and the supply of United States coal.
(2) Price control measures other than subsidies.
(3) Manpower for the mines and coal deliveries.
(4) Coal conservation.
(5) Price increases resulting from wage increases.
(6) Import and domestic subsidies; Commodity Prices Stabilization Corporation Limited.
(7) Production subsidies, loans and grants; the Emergency Coal Production Board.
(8) The Hamilton Coke Ovens.

(1) *Coal Distribution and the Supply of United States Coal*

At least until the formation of the Emergency Coal Production Board, the principal problem with which the Administrator had to deal was the distribution of coal. The gradual increase in war production, the establishment throughout the country of military camps which used up to one and a half million tons per year, the problem of shipping on the Atlantic Ocean and on the St. Lawrence, and the shifts in population caused by the war, changed considerably the normal flow of coal from producer to consumer. In peacetime, a large proportion of the Nova Scotia output was carried to the St. Lawrence markets by fast vessels with facilities for rapid loading and discharge. With the gradual requisitioning of these vessels by the Admiralty and the substitution of slower vessels, and later the submarine campaigns, it became increasingly difficult to arrange for the water movement of Nova Scotia coal to central Canada. At the same time, the consumption of coal increased in the Maritimes. Railway consumption in the eastern provinces doubled from 1939 to 1944, and the expansion of the steel industry at Sydney increased the local demand for coal. These factors, together with the decrease in production in that field and the substitution, in part at least, of local bituminous coal for British anthracite, resulted in the movement of Nova Scotia coal on the St. Lawrence falling from three and a half million tons in 1939 to less than half a million tons in 1945.

An attempt was made to offset these decreases by the movement of western coal into central Canada. Shipments of this coal expanded to over one million tons in 1941 but as the strain on transportation facilities increased and as the coal requirements of the western provinces and the northwestern States grew, these shipments into Ontario gradually declined.

Meanwhile the demand for coal in the industrial provinces of Ontario and Quebec was increasing rapidly, and as the supply of Canadian coal diminished increasing quantities of United States coal both for domestic and industrial purposes were required. Up to the end of 1942 there was no particular difficulty in procuring sufficient United States industrial coal, though full advantage had to be taken of the navigation season on the Great Lakes and the practice of stocking coal on the docks and in the industrial plants had to be encouraged by the Administrator. In the field of domestic coal more difficulty was encountered, for the withdrawal of Scotch and Welsh anthracite from the markets caused a corresponding increase in the consumption of United States anthracite which was in short supply.

During that period the Administrator's chief problem was the diversion of existing supplies to points where temporary shortages existed. In order effectively to perform this function, full information as to production, supply and requirements both as to quantity and grade of coal was necessary. The first step taken to this end was the approval of P.C. 3470 on November 2, 1939, authorizing the Wartime Prices and Trade Board to require that licences be obtained by all persons dealing in coal and coke. This was followed on November 7 by Administrator's Order No. 1 requiring all persons licensed to report stocks on hand or in transit. The problem of making available supplies of particular grades of coal to areas and industries where the need was greatest was solved mainly by the co-operation of the producers, distributors and principal consumers, although the Administrator increasingly used his powers to direct individual consumers to take their coal from designated areas.

Gradually, however, the picture changed and supply became more and more important, and with the formation of the Emergency Coal Production Board in November 1942, the extremely severe winter of 1942-43, and the establishment of Coal Control in March 1943, more complete supervision over the coal industry was assumed.

The year 1943 was marked by a continually increasing demand for coal and by strikes in the coal fields of both Canada and the United States. Scattered strikes, mostly local and in many cases unauthorized, occurred in both eastern and western Canada, and in April 1943 a strike of larger proportions occurred in the bituminous mines in the United States. Unsettled conditions in both the bituminous and anthracite fields of the United States dragged on from month to month, with small work stoppages occurring from time to time. The activities of Coal Control and its American counterpart, the Solid Fuels Administration, were closely co-ordinated, and to make this liaison effective a number of Coal Controller's Orders were issued, many of which were suspended and re-imposed as conditions required.

Following the American strike, on April 30, 1943, Order No. 4 froze shipments of bituminous coal in transit and gave the Controller power to direct their disposal. It also prohibited deliveries of bituminous coal to Ontario and Quebec dealers, except as directed by the Controller. This order was suspended on May 3. Order No. 4B dated June 1 prohibited, except by permit from the Controller, all deliveries of anthracite except in one ton lots or to buildings or plants with less than two tons on hand, and deliveries of bituminous coal except to consumers whose annual consumption was 25 tons or less or where emergency conditions existed.

For the purpose of facilitating even distribution of coal supplies for domestic heating in Ontario and Quebec, Order No. 5 issued on July 5, 1943, established classifications of coal, required a system of reporting by consumers, and curtailed deliveries to one-half the year's requirements unless the householder agreed to use industrial coal or coke for domestic heating to the extent of one-quarter of his total requirements. This order was amended on September 16 to give priority in deliveries to persons with less than one-quarter of their annual requirements on hand.

A number of orders were made during the summer and fall of 1943 by the United States Solid Fuels Administration, establishing priorities with respect to distribution in the United States and for the purpose of moving the greatest possible amount of coal during the season of lake navigation. As we were largely dependent on American supplies, similar orders were issued here. Order No. 7 dated August 26 required purchasers of United States bituminous coal to notify the Controller of the amount by which their requirements for the ensuing winter exceeded their stocks on hand and on order, so that the Controller could make arrangements for the necessary deliveries with the assistance of the American

authorities. This order required commercial dock operators to deliver to the most necessitous customers and required consumers who received coal by rail to use their stockpile so far as possible.

Order No. 8 of September 27, 1943, provided for equitable distribution amongst retailers during the ensuing winter by regular monthly shipments, so far as possible, of available supplies of anthracite. Except in areas with increased population or where shortages of other fuels existed, deliveries were limited to 90 per cent of the deliveries made during the "standard period" of April 1, 1942, to March 31, 1943.

Deliveries to domestic consumers were restricted by Order No. 10 of November 2, 1943, to those who had less than fifteen days' supply on hand, which order required the consumer to accept any available type of coal suitable to his burning equipment. This order was suspended in the four western provinces on January 26, 1944.

On November 30, 1943, again to adjust Canadian distribution to American supply, Order No. 11 (called the Import Bituminous Coal Stock Equalization Order) imposed limitations on orders and deliveries of such coal at a certain percentage of the monthly requirements depending on the number of days' supply on hand according to a stock limitation table set out in the order, and required notification of all orders to Coal Control. On the same day Order No. 12 instituted a system of priorities in the delivery of domestic coal to private residences to provide first for deliveries of a minimum of fifteen days' supply to consumers with less than seven days' supply on hand, and to prohibit delivery of more coal than sufficient to supply domestic requirements to May 1, 1944.

The years 1944 and 1945 saw no change for the better in the coal situation. Production in the Maritimes continued to decrease and, while partially offset by increased production in the west, assisted by the Government-sponsored strip mines in Alberta, the total Canadian production continued to fall from the maximum levels which had been reached in 1942. Consumption meanwhile, both in Canada and the United States, continued at a high level. Reserve stocks in industrial plants and at commercial docks gradually diminished; the manpower situation both in the mines and for coal deliveries became more critical, and shortages of shipping space and railway cars became more acute. These factors combined to require even closer supervision by the Coal Controller.

From the end of 1943 until March 30, 1946, a series of orders were made and subsequently rescinded. The general pattern remained about the same. Industrial consumers and persons maintaining storage docks were encouraged to obtain all the coal possible during the summer months when advantage could be taken of lake navigation, and householders were encouraged to obtain their winter's supply as far as possible in advance. Shortages of anthracite were compensated for, in part, by the use of bituminous coal and coke in household burning equipment; and industries were obliged to use their stockpiles during periods of extremely short supply. Stock limitation tables for industrial consumers and percentages of bituminous coals required to be taken with purchases of anthracite were varied from time to time, depending on the season and the present and prospective supply and requirements.

On November 1, 1945, the Solid Fuels Administration in the United States prepared to discontinue its activities, although subsequent events required that it resume business. It was not possible to discontinue immediately control over distribution in Canada but control was greatly relaxed, and on March 30, 1946, Order No. 23 was issued rescinding all existing orders of the Coal Controller. Coal control prepared to go out of existence, but subsequent developments made this impossible and required the re-institution of a considerable measure of control. Anthracite continued in short supply, and Order No. 25 issued June 6, 1946, and still in effect as this is written, provided generally that a consumer of coal for domestic purposes could not order more than the amount consumed by

him between April 1, 1945, and March 31, 1946. It also restricted deliveries to the consumer up to November 1 to 80 per cent of his normal annual requirements, and in the case of preferred domestic fuels to 60 per cent.*

While the supply of bituminous coal appeared to be adequate, a strike in the American coal fields which occurred in April, and the subsequent shipping strike on the Lakes and the St. Lawrence, have combined to cause the loss for coal importation purposes of a substantial portion of the 1946 navigation season. Due to a shortage through wartime casualties of a number of the smaller vessels normally used for the transportation of coal to the lower St. Lawrence, the situation is particularly serious in that area, it being estimated that two and a half to three months of the navigation season have been lost. Up to date there have been no new general orders controlling the movement of bituminous coal, but the Controller has been obliged to maintain daily contact with the Canada Shipping Board in order to make the best possible use of available shipping space.

The shortage of railway cars has also contributed to the complexity of the problem of current coal movement. Although the general strain of wartime transportation has been eased, the large grain crop in the west, combined with the inability to replace cars worn out in wartime service, has required close co-operation between Coal Control and the Transport Controller to make available the minimum number of cars required for the rail movement of coal.

The eight regional offices of the Coal Controller have been throughout of great assistance in making available to the Controller the necessary information on the supply and requirements of each locality. Of great assistance too were the Regional Solid Fuel Representatives, one appointed for each province by P.C. 7002 on October 1, 1943, who, serving without remuneration, cleared local coal problems and arranged methods of allocation best suited to local requirements.

(2) *Price Control Measures Other than Subsidies*

The freezing order imposed on November 1, 1941, by P.C. 8527 provided that the maximum price at which any person might sell any goods should be the highest lawful price at which that person sold goods of the same kind and quality during the basic period, and stipulated that the differences in price customarily allowed during the basic period to different classes of buyers or for different quantities or under different conditions of sale should be continued. P.C. 8528 approved the same day, gave the Board power to fix specific or maximum or minimum prices and specific or maximum or minimum mark-ups which might be either above or below the basic period prices or mark-ups of a particular dealer, and to prohibit sale at other prices or on other margins of profit. Authority was delegated to Administrators to exercise this specific price fixing authority by Order No. 76 on December 16, 1942. Consequently, save where specific prices or specific mark-ups were fixed, the general pricing practice of each producer, wholesaler and retailer as it existed during the basic period governed his activities thereafter.

Measures designed to ensure the sale of coal in Canada at the prices prevailing during the basic period in the face of increasing costs took several forms. Import subsidies applying to coal imported for domestic use only, and production and transportation subsidies applying to Canadian coal, whether consumed by industry or by the householder, were perhaps the most important and will be dealth with later in this chapter as will the subsidy which was in effect for a time which compensated for wage increases granted to the miners. Other measures taken were principally tariff and War Exchange Tax adjustments, general price fixing orders, and price directions to specific producers, wholesalers or retailers.

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* Since this was written, Controller's Order 25A dated October 24, 1946, has increased these percentages to 100 per cent and 80 per cent respectively.

The first step taken in connection with tariffs and the War Exchange Tax was P.C. 394 of January 29, 1942. Due to the diminishing supplies of British coals to the Maritimes and the increased cost of water transport of United States coals to these Provinces, the 10 per cent War Exchange Tax and the customs duty of 50 cents per ton were removed on anthracite coal from non-British countries entering ports in the Maritimes. At first limited in point of time, this order was extended indefinitely by P.C. 3472 on April 28, 1942; and by P.C. 350 on January 14, 1943, it was extended so far only as the War Exchange Tax was concerned to all importations of anthracite into Canada.

Similarly, as a measure designed to control prices, coke imported for heating and cooking purposes was exempted from the War Exchange Tax and the customs duty of $1.00 per ton by P.C. 4488 on May 28, 1942, the order being clarified by P.C. 8042 on September 9, 1942. Again for the same purpose, P.C. 10824 dated December 1, 1942, exempted imports of coal briquettes from the United States (when imported through any customs port between Port Arthur and the Saskatchewan-Alberta boundary), from the customs duty (of 50 cents in the case of anthracite and 75 cents in the case of bituminous) and from the War Exchange Tax. At first limited to the period ending March 31, 1943, this exemption was continued by P.C. 1517 dated March 1, 1943.

These orders, together with the general Orders in Council of December 19, 1941, and January 20, 1942, referred to in the chronological history of wartime controls, reducing the value of all goods for duty purposes, and abolishing the anti-dumping duty, were of great assistance in obtaining supplies of United States coal within the ceiling. Apart from these changes and a few other minor adjustments, the tariffs on coal existing prior to the war have continued until the present time and are dealt with in the chapter of this report on Subventions and Other Aid.

General price fixing orders were few in number and usually related to the mine prices of particular coals, to retail prices on coal in specific areas, or to wholesale margins. Apart from the orders allowing price increases to compensate for increased wages, dealt with later in this chapter, there were issued all together about 21 orders of this nature. To avoid the possibility of pyramiding wholesale margins, Order No. A-964 was issued on November 5, 1943, fixing the maximum wholesale margin on bituminous coal shipped by rail to retail dealers at 45 cents per ton regardless of the number of wholesalers through whose hands it passed. Another order was required to grant wholesalers of anthracite a small margin of profit on coal obtained from mines which were not in the Canadian trade prior to the war and who refused to grant a trade discount as was the custom with the regular suppliers. In this case, the retailer was obliged to take the "squeeze" as no corresponding increase in the retail price was permitted. A recent order made July 24, 1946, has exempted western producers of domestic coal, who during the depression of the 'thirties had granted trade discounts to large purchasers or exclusive wholesalers running as high as 65 cents per ton, from the section of the maximum prices regulations continuing trade discounts in effect during the basic period, so that they might re-negotiate their contracts in the light of existing conditions and reduce these margins where conditions no longer warranted their continuance. In cases where such mines are receiving production subsidies, Coal Control insists on re-negotiation unless satisfied that the existing wholesaler's margin represents a service of comparable value rendered by him.

Price directions to particular mines, wholesalers, and retailers, and with respect to particular cities, have been issued in many cases to help correct anomalies arising out of the freezing of prices as at a particular period. In many cases, this meant that two retailers in the same town might have different prices for the same grade of coal. Many such cases still exist but many have been corrected by specific direction. One such anomaly was the fact that western domestic

mines had, during the basic period, varying mine prices depending on the destination of particular shipments, lower prices being applicable with respect to areas in which the producer was attempting to build up business. Ontario shipments, for example, carried a lower mine price than coal sold locally. The Administrator permitted such mines to place all shipments on the same basis as local sales which meant, in that particular case, an increase in the retail price of such coal in Ontario. Specific price directions had also to be made in many cases to cover sales by a dealer of a particular grade of coal which was not handled by him during the basic period.

Except for adjustments for the purpose of equalizing prices in particular areas, or to eliminate abnormally high or abnormally low discounts, and except for increases given to allow for specific wage increases, the price of coal, for domestic consumption at least, was held generally at the basic period prices.

(3) *Manpower for the Mines and Coal Deliveries*

Throughout the entire history of Coal Administration and Coal Control, the industry suffered from a shortage of labour. Enlistments, availability of other and more attractive employment, and decrease in efficiency of labour due to inexperienced and over-age men in the coal fields all contributed to this shortage.

The part played by Coal Administration and Coal Control in this sphere consisted of continuous liaison, for part of the war period by means of a joint Committee, with the Department of Labour, National Selective Service and the Army authorities, so that the responsible officials might be kept informed of the effect of labour policies on the output and distribution of coal.

The officials of Coal Control were influential in persuading Army authorities to grant leave during the seasons of greatest emergency to members of the Armed Forces who were experienced in coal mining, provided they return to the mines. They were also instrumental in securing the approval on May 17, 1943, of P.C. 4092, already referred to, which provided that coal miners could not leave their employment, that a mine operator could not dismiss a miner without permission from the Selective Service office, and that no person with two years or more experience in coal mining might remain in any other employment. This order also prohibited coal miners from joining the Armed Forces either by enlistment or draft prior to January 1, 1944, this prohibition being extended (P.C. 1355, March 4, 1944) to August 1, 1945. It also reduced the age of employment in coal mines to 16 years for males, and permitted the employment of females 18 years of age or more in surface work in the Alberta mines.

To assist in providing coal deliveries, which from time to time became a very serious problem, the offices of Coal Control were able to secure the approval on September 7, 1943, of P.C. 6632 prohibiting the call-up or enlistment of any coal delivery man in any city of 50,000 persons or more until February 1, 1944. This prohibition was extended to February 1, 1945, by P.C. 5771 dated July 27, 1944. Assistance in this direction was also secured by the decision of the Army in March, 1944, to undertake the delivery of all of its coal requirements.

(4) *Coal Conservation*

When the coal situation became serious during the summer of 1943, P.C. 6373 was approved on August 11, making it an offence generally to waste fuel and giving the Controller authority to make orders in relation to the use and consumption of coal, with a view to preventing its waste. A few days later, on August 16, by Coal Order No. 6, the Controller established the National Coal Conservation Committee composed largely of combustion engineers and technical men whose duties were to confer with and advise the Coal Controller with respect to the conservation of coal and coke and to investigate and make recommendations concerning the kind of coal and the kind of burning equipment used by any industry or person. This Committee directed its activities largely to

publicity. It issued a 16-page booklet containing suggestions on coal conservation, which booklet was given Canada-wide distribution. It also carried out a newspaper advertising campaign with the same object in view and through the use of this medium, news releases, and dramatized radio spot announcements brought the seriousness of the problem to the attention of the Canadian people. A sub-committee investigated the possibility of coal savings in the railways and with the co-operation of the railroads was able to effect considerable savings. Industrial consumers were kept in close touch with the fuel situation and their co-operation was secured in the direction of coal conservation, and through the co-operation of various associations, and of such large users as hotels, churches, theatres and greenhouses, still further savings were made. It is impossible to estimate in tons of coal saved the results of the activities of the Conservation Committee, but undoubtedly their efforts did assist materially during periods of extreme coal shortages. The Committee suspended operations on March 31, 1946. The cost of the advertising program to the Government was $220,781.57.

(5) *Price Increases Resulting from Wage Increases*

The chapter of this report dealing with industrial relations reviews in detail the wage situation in the mining industry and it is necessary here to deal only with wage increases in so far as they affected prices.

Prior to the freezing of wages and prices in the fall of 1941 there had been some wage adjustments which in some cases had been reflected in price increases. The Government's declaration of policy concerning labour on July 19, 1940, had suggested the possibility of taking care of wage adjustments, where necessary by reason of war conditions, in the form of bonus payments. In line with this policy two Commissions, one in the West set up at the request of the operators and miners, and an Industrial Disputes Inquiry Commission in the Maritimes, had recommended payment of a cost of living bonus. In December 1940, P.C. 7440 was approved, establishing for the guidance of conciliation officers a cost of living bonus plan on a somewhat different basis. As a result, the increases suggested by the two Commissions were superseded by the plan set out in this Order in Council which was adopted by the larger mines in both regions in the Fall of 1941.

The price freezing order was about to be issued at that time and as it was quite apparent, as a result of investigation by the Coal Administrator, that the companies were, generally speaking, unable to take care of increased costs resulting from the cost of living bonus without either a price increase or Government subsidy, the Administrator authorized a surcharge on coal sales in an amount sufficient to recompense the operator for the payment of the cost of living bonus. This surcharge amounted to 22 cents per ton in the Maritimes and varying amounts ranging from zero to 30 cents per ton in other districts, depending on the man-day production in the particular area and the grade of coal involved.

By circular from the Administrator to the industry on October 17, 1941, ratified by the Wartime Prices and Trade Board on December 1, the surcharge to take care of this first cost of living bonus was directed to be shown as a separate item on all invoices, but following the commencement of subsidy to take care of further increases in the cost of living bonus this surcharge was by Administrator's directive of March 2, 1942, absorbed in the price of coal.

Demands for wage increases in the western field in 1943 resulted in the appointment of a Royal Commission, presided over by the Honourable Mr. Justice O'Connor of the Alberta Supreme Court. The report of that Commission on November 17, 1943, recommended a wage increase of $1.00 per day, retroactive to November 1, and two weeks' holiday each year with pay. The Commission also reported that an investigation of the financial statements of the operators seemed to indicate that they could not continue to produce coal in the

face of these increased costs, without some assistance in the form of a price increase, and intimated that an increase in the price of coal of 40 cents per ton would be necessary. It was decided by the Government that this suggestion be made effective, the increase to be in such amount as might be determined by Coal Control after a complete investigation. As a result, Administrator's Order A1008 was issued on November 30, increasing the mine prices for certain western mines and giving the operators of other mines the right to apply for increases. It provided that in such cases the Administrator, if he decided an increase in price was required, could specify the amount of the increase. It also gave the distributor the right to pass on, after December 1, so much of the increase as might be charged to him. This increased price ranged from $1.00 on Alexo and Saunders Creek lump coal down to 10 cents per ton on slack coal from certain areas. Sixty five cents per ton was the general increase on Alberta "domestic" lump coal but the Order provided that on March 31, 1944, this would decrease to 50 cents per ton, it having been made larger in the earlier period on account of the retroactive feature of the O'Connor award. Coal prices at all the western mines were brought into line by subsequent orders.

The Nova Scotia miners immediately requested a similar increase. Their application to the National War Labour Board resulted in a decision dated December 3, 1943, which, while criticizing the O'Connor award, provided that the Nova Scotia miners should be in no worse position and granted a similar increase of $1.00 per day, retroactive to November 1, and one week's vacation each year with pay. Following this, Administrator's Order A1054 of December 31, 1943, increased the price of coal sold after January 1, 1944, from certain mines by 95 cents per ton, the increase being greater in Nova Scotia due to its smaller man-day production. This price increase was extended later to other Nova Scotia mines by Order A1121 of February 5, 1944, and Order A1185 of May 1, and was extended to the New Brunswick mines by Order A1122 of February 28, and Order A1166 of April 26, 1944.

While the increase in price in the Alberta field was reduced March 31, 1944, from 65 cents to 50 cents per ton in the case of popular "domestic coals", the 95 cents increase in the Maritime coal fields fell short of meeting the increased costs due to the award, and as a consequence, the price increase stood beyond that date.

While there was a considerable amount of public confusion as to the relation of the price increase to the wage increase, the price increase was calculated quite accurately according to a set formula. The wage increase involved a corresponding increase in the Provincial Workmen's Compensation assessments which were largely based on the payroll. From production figures supplied by the mines in each district, an average production per man-day was determined and the wage increase including the increase in compensation was expressed in terms of cents per ton of coal. The increased cost of production resulting from vacation pay was then taken into account and added to the basic figure which had been established. The retroactive feature of the award was then compensated for in terms of cents per ton and the resulting figure was taken as the basic increase. This was then apportioned amongst the various grades of coal produced from mines of each district on the basis of the tonnage of each sold. As no two mines in each district had exactly the same productive capacity, this meant some maladjustments as between mines but it was considered that this was a more practical approach than a different price increase for each mine in the area.

Demands for further wage increases in the Nova Scotia and New Brunswick fields, and for an additional week's holiday as granted the western miners, led to the appointment of an Industrial Disputes Inquiry Commission presided over by the Honourable Mr. Justice Carroll. The recommendations of that Commission were not accepted by the employees and the matter was subsequently

referred to the National War Labour Board. The Board's decision regarding certain companies, given on October 12, 1945, provided that 33 cents on each ton of coal mined and sold prior to February 1, 1947, be set aside to provide a fund to give the miners an additional week's holiday and an increase in pay of 17 cents per shift. This also was passed on to the purchaser in the form of an increase in the price of coal of 33 cents per ton by Administrator's Order A1709 of August 14, 1945. By subsequent Orders, these arrangements were extended to other mines in Nova Scotia and New Brunswick.

As this report was being written, agreements between the operators and miners in the western Canadian coal fields, providing for a wage increase of $1.40 per day and a 3 cents per ton welfare fund, were concluded and approved by the National War Labour Board. These increased costs were also passed on in the form of an increase in price to the consumer. Administrator's Orders A2159, A2160 and A2161, made October 31, 1946, granted respectively an increase of 85 cents per ton on Alberta and Crowsnest Pass bituminous coal, increases ranging from zero to $1.75 per ton on Alberta "domestic" coals, depending on the grade and the mining area, and an increase of $1.50 per ton on Vancouver Island coal. Subsequent Orders have granted similar increases to Alberta mines not included in the earlier Orders and some increases to Saskatchewan producers.

These were the only cost of living bonuses or wage increases that during the entire period after the freezing of prices were passed on to the consumer, and were indeed the only price increases on coal except for such as were mentioned in the section of this chapter dealing with price control. Other increased labour costs were taken care of by domestic subsidy through Commodity Prices Stabilization Corporation Ltd., and after that subsidy ceased on the absorption of the cost of living bonuses into the basic wage rate on December 9, 1943, by production subsidy, through the Emergency Coal Production Board, in cases where the particular mine could not absorb the increase. Both of these subsidies are dealt with later in this chapter. These price increases applied to all Canadian coal whether for domestic or industrial consumption.

It was a cause of some public resentment in the West and in the Maritimes that any of these increases in labour costs should be passed on to the consumer in the form of a surcharge or increase in the price of coal, while increases in mine prices on coal imported for domestic use—and this affected central Canada principally—were taken care of by subsidy without any price increase to the consumer. This import subsidy, as will be seen in the section dealing with that subject, amounted, at one period, to as high as $3.94 per ton. It is, however, only fair to state that the central Canadian consumer had, before the basic period, absorbed considerable increased cost on imported coal, and consumers in both the East and the West benefited to a considerable extent from production and cost of living bonus subsidies.

(6) *Import and Domestic Subsidies; Commodity Prices Stabilization Corporation Ltd.*

It has been shown earlier in this chapter that the increase in cost of imported goods was the cause underlying the formation of Commodity Prices Stabilization Corporation Ltd. Its activities, however, were not confined to subsidizing imports. Through it were paid several types of subsidy, import and domestic, and by varying methods. These subsidies, as related to coal and coke, are classified by type and method of handling as follows:

(i) Domestic Subsidies

(a) Cost of Living Bonus Subsidies—As indicated in the preceding section of this chapter, the first cost of living bonus, whether under special awards, agreements, or P.C. 7440, was passed on to the consuming public as an increase in the price of coal.

When, on October 27, 1941, P.C. 8253 extended to all principal mines the obligation to pay the cost of living bonus calculated as set out in the Order, this meant in many cases a further increase in labour costs. The subsidy principle having meanwhile been adopted with the incorporation of Commodity Prices Stabilization Corporation Ltd., the Coal Administrator by a circular to the trade issued March 2, 1942, provided that the operators might apply for assistance by way of subsidy, and a minute of the Wartime Prices and Trade Board of April 7, 1942, authorized the Corporation to pay such subsidies, subsidies being made generally retroactive to the time of the institution of the first cost of living bonus. Due to varying degrees of productivity of labour in various areas and in different mines in the same area, the subsidy could not be related to the coal tonnage with any degree of accuracy; consequently, it was related to man-days bonused. Maximum rates of assistance were determined for each district and type of operation, and the subsidy was calculated by crediting the number of man-days at the specified rate for the area and debiting the existing rate of price increase on the tonnage of coal shipped. Not all mines were assisted, as those with high man-day production found themselves in no need of assistance other than the price increase. Subsidies were paid only after full production and employment information was supplied to the Administrator and he recommended payment.

As the cost of living index varied from time to time, increases having been directed by the National War Labour Board on August 15, 1942, and November 15, 1943, corresponding adjustments of the maximum rate of assistance had to be made, based on the new rate of bonus. The assistance also had to be varied to take into account some increases in Workmen's Compensation assessment rates, as well as increases in Workmen's Compensation resulting from the bonus payments. Maximum rates of subsidy against which the surcharge was debited ranged from 0.06 cents to 71 cents, depending on the time, the area, and when the operator began paying the bonus.

As the Excess Profits Tax rate was increased to 100 per cent in 1942, it was decided after due consideration, that the subsidy should not be related in any way to the profit of the particular mine.

The cost of living bonus subsidy was in addition to any production subsidy which was granted after the Emergency Coal Production Board was established, but was shown as a credit in arriving at the profit and loss position of the company when considering its application for production subsidy. Production for all purposes was included in calculating the subsidy, except for man-days employed in producing coal for export or for deep-sea bunkers, which, during the latter period of this subsidy, were excluded.

P.C. 9384 of December 9, 1943, merged the cost of living bonus with the basic wage rate, and this type of assistance by way of subsidy was discontinued as of the pay period beginning on or after February 15, 1944. Thereafter the increased labour cost due to these bonuses might or might not be subsidized, depending on whether or not the particular mine might qualify for the production subsidy in accordance with the policies of the Emergency Coal Production Board.

Taking the larger western mines as an example, the cost of living bonus increased from 18 cents per man per day in the early part of 1941 to 77 cents just prior to its merger with basic wage rates. Total cost of living bonus subsidies, instituted solely for the purpose of maintaining the price ceiling, amounted to $3,223,992.53.

(b) Bituminous Coal for Coking.—Three municipal gas plants, those of Owen Sound, Guelph and Belleville, due to the stabilization of the price of gas and increasing coal costs, were unable to carry on without a loss. A domestic subsidy was, therefore, granted to them to take care of the increase in price of the coal imported by them over the cost of the same coal in 1941. The sub-

sidies were not, however, to exceed in the aggregate a sum sufficient to provide for losses. The total amount paid by way of subsidy up to March 31, 1946, amounted to $36,468.94 and the total tonnage subsidized amounted to 28,266 tons. This subsidy was discontinued on March 31, 1946, as price increases were allowed on the products of these plants.

(c) Emergency Diversion Subsidies.—P.C. 1752 of March 5, 1943, which established Coal Control, gave wide powers to allocate coal and to direct consumers to accept coal from particular mines. Coal Controller's Order No. 4 of May 10, 1943, which froze rail-carried bituminous coal in transit also gave the Controller authority to divert same to points where it might be most needed. A Minute of the Wartime Prices and Trade Board dated May 11, 1943, authorized the Commodity Prices Stabilization Corporation Ltd. to pay a domestic subsidy on coal to reduce the increased costs arising out of the diversion or redistribution of coal or the use of a higher grade of coal.

During the following years a number of such diversions were directed. In particular, the British Columbia Gas and Electric Company was directed to use coal from the Crow's Nest Pass Coal Company for its coke and gas plant in place of Vancouver Island coal. Similarly, the Vancouver General Hospital was obliged to substitute McLeod River fines for Nanaimo-Wellington fines. The Winnipeg General Hospital and the Winnipeg Electric Company were obliged to take United States coal in place of coal from the Crowsnest Pass and the Winnipeg School Board was obliged to use United States coal in place of the Canadian coal normally used by it. In all these cases, the companies and institutions concerned were paid the difference in price between the coal directed to be used and the coal which it replaced, the difference in the characteristics of the substituted coals being taken into account in adjusting the price difference. Subsidies were also paid to the Dominion Steel and Coal Corporation Limited, for coke diverted from Sydney to the Montreal area and other Quebec points to alleviate fuel shortages there, to enable that Company to sell coke at the price established in the areas to which it was diverted. Dealers in Windsor were also paid a subsidy on coke being diverted to that point from Hamilton to take care of their difference in cost and enable them to sell under the ceiling price established for Windsor. Subsidy was also paid to dealers in Halifax and Saint John for stockpiling coke purchased from the Dominion Steel and Coal Corporation Limited during the summer of 1945 to offset the expected shortage of anthracite during the 1945-46 season. The amounts paid for this ranged from 85 cents to $1.65 per ton and took care of such things as the rental of storage space, degradation, financing and extra handling. The total amount of subsidies paid to cover all such diversions up to March 31, 1946, amounted to $283,387.31.

(d) Maritime Transportation Subsidies.—In normal times, British anthracite delivered in the Maritimes was either shipped direct to the various localities or was transhipped from Halifax or Saint John to the local distributing points by schooner. Due to the fact that the schooners were taken out of service as a result of the war, and the ocean-going vessels were obliged to dock at Halifax and Saint John only, all the coal had consequently to be carried to the distributing point by rail or truck. This involved higher transportation costs and the Wartime Prices and Trade Board on September 24, 1942, empowered Commodity Prices Stabilization Corporation Limited to pay assistance in this respect, as approved by the Coal Controller. These subsidies were payable to the retailers and were limited to the amount necessary to provide a gross margin of profit not to exceed $2.50 per ton, increased to $3.50 after March 31, 1946.

On December 21, 1943, coal dealers in Nova Scotia were granted a subsidy on coke purchased by them from the Dominion Steel and Coal Corporation Limited to the extent that their present cost of transporting the same by rail and water from Sydney exceeded the basic period cost of water transportation.

This latter subsidy was changed on September 7, 1944, to a flat rate basis of 25 cents per ton and was extended to include coal from the Dominion Coal Company as well as coke. As on September 1, 1945, coal dealers were permitted to increase their maximum selling price by $1.00 per ton on coal and $1.50 per ton on coke, this particular subsidy was discontinued and a new one substituted to the extent necessary to protect gross margins established by the Coal Administrator. The total of all subsidies paid with respect to coal and coke transportation in the Maritimes amounted as at March 31, 1946, to $35,849.15.

(e) Wagon Mines Transportation Subsidy.—During the severe winter of 1942-43 a shortage of fuel developed in certain sections of the western plains and to encourage production from some of the smaller mines in those areas, a direct subsidy of 20 cents per ton was authorized, which subsidy was limited in point of time. The total subsidy amounted to $1,084.43 and was paid by reimbursing the distributors for the similar payment which they made to the mines.

(f) Algoma Coke Subsidy.—In January of 1944, due to strikes in the American anthracite fields, export of anthracite to Canada was for a time suspended. This action created a serious situation for domestic consumers in central Canada. The Coal Controller, therefore, arranged with the Algoma Steel Corporation to divert coke produced at its plant at Sault Ste. Marie from its steel manufacturing operations for sale to civilian consumers. Assistance to wholesale and retail dealers, however, was required to enable them to sell at the established prices for coke and, as a consequence, the Wartime Prices and Trade Board authorized the Commodity Prices Stabilization Corporation to pay a domestic subsidy to the extent that the dealers' costs including commission, as established by the Coal Controller, might exceed the dealers' selling prices. At first this subsidy was based on sales but by an amended Minute of the Wartime Prices and Trade Board dated October 4, 1945, in order to encourage stocking during the water navigation season, it was extended to permit payment of the subsidy whether or not the coke had been actually sold. The total subsidy paid with respect to the sales of Algoma coke, prior to March 31, 1946, was $2,714,430.45, the coke being distributed to practically all points in Ontario east of the head of the lakes. The total tonnage involved was 930,750 tons. The rate exceeded $3.90 per ton in a few isolated cases.

(g) Production Assistance Prior to Formation of Emergency Coal Production Board.—The Emergency Coal Production Board, whose activities will be dealt with later, was authorized to make payment to producers for losses incurred in their operations from April 1, 1942. It was later considered that the losses should be reimbursed as from the first of the year, and consequently, by Minute of the Wartime Prices and Trade Board dated April 13, 1943, Commodity Prices Stabilization Corporation was authorized to make an accountable advance to Acadia Coal Company Limited in respect of losses incurred during the first three months of the year 1942 plus a portion of standard profits for that period. Subsequently, the same treatment was accorded to Dominion Coal Company Limited. The net amount of such assistance through Commodity Prices Stabilization Corporation was $378,554.68.

(ii) Import Subsidies

The payment of import subsidies commenced some time following the approval on December 17, 1941, of Order in Council P.C. 9870 incorporating Commodity Prices Stabilization Corporation Limited and the statement of the Wartime Prices and Trade Board referred to earlier stating the principles on which subsidies would be paid.

Import subsidies, generally speaking, were designed to offset the increase in laid-down cost of imported consumer goods between the basic period September 15 to October 11, 1941, and the price actually paid on current importation. Import subsidies in the case of coal and coke might be classified under three headings, United Kingdom anthracite, United States anthracite and United

States bituminous coal, coke and briquettes. Except as hereunder noted, import subsidies related only to consumer purchases as distinct from purchases for industrial purposes.

On March 31, 1942, the Deputy Coal Administrator issued a statement to the effect that coal and coke would be eligible for subsidy, the subsidy to be payable to the importer who acquired title to same from a non-resident supplier, and to be payable only with respect to coal and coke supplied to domestic users of 100 tons or less per annum or to hospitals, churches, schools and other non-profit institutions. This was widened on March 30, 1943, to include coal and coke used in heating any building, or to provide customary and necessary services in and for buildings, except for Government purchases and purchases by public utilities, railways and industrial users. The definition of consumer purchases, however, was again restricted on May 1, 1945, to coal and coke imported for heating any place of dwelling other than an hotel, and for schools, hospitals and the like.

The subsidy applied to any imported consumer coal but until March 31, 1946, coal imported from Great Britain was handled on a somewhat different basis than that imported from the United States. Prior to December of 1941, the British Treasury had been subsidizing coal imported into Canada from Great Britain to the extent of approximately 5 shillings per ton, and this British assistance continued throughout. With the adoption of the import subsidy plan in Canada, however, additional costs such as increased mine costs, increased insurance premiums, and war and marine risk costs in excess of those in effect in 1941, were by arrangement borne by the British Ministry of Fuel and Power in order that British anthracite could continue to be invoiced to Canadian importers at the price in effect during 1941, and reimbursement to the British Ministry was made by Commodity Prices Stabilization Corporation Limited annually, on the recommendation and with the approval of the Coal Administrator.

With respect to coal imported after March 31, 1944, the British Ministry of Fuel and Power was not reimbursed directly but this item was included in the agreement between the two Governments respecting the overall financing of the war as was the special subsidy of 5 shillings per ton referred to above. After March 31, 1946, British anthracite was treated in the same manner as coal imported from the United States. It was no longer subsidized by the British Government, but subsidy was paid by the Canadian Government to the importer to reimburse him the difference in his laid-down costs.

The only other subsidy paid with respect to British anthracite under the classification of import subsidy was the payment to distributors resulting from increased transportation cost in bringing this coal into Ontario and Quebec, necessary because the St. Lawrence estuary was closed to navigation and the coal had to be brought to that area by rail from Atlantic ports. The maximum rate of this transportation subsidy was $2.50 per ton.

With respect to United States anthracite, the subsidy was paid to importers to take care of the increased mine prices over those in effect during the basic period, there being no substantial change in transportation costs on this coal which was practically all brought in by rail. United States anthracite from the basic period up to the present time has undergone several price increases, the popular grades having increased in mine price from $6.75 per ton, April 1, 1942, to $9.00 and $9.50 on November 30, 1945, and $10.15 and $10.65 on June 25, 1946, depending on whether from "line" or "independent" mines. The removal of the War Exchange Tax took care of the first price increase of 55 cents per ton and made $7.30 the basic price throughout the entire period, plus, of course, exchange on that amount. For the purpose of simplicity in administration all anthracite coal was considered to be purchased for heating purposes and eligible for subsidy, although a small portion may have found its way to industry.

United States bituminous coal, coke, and briquettes were subsidized in the same way, where used as consumer goods rather than by industry. In the case of such fuels, however, increased transportation costs as well as mine price increases had to be subsidized. Most bituminous coal is brought in by water, and water transportation costs have undergone several changes; and considerable of the coal had also at various times to be brought in by long rail haul. It was also necessary in the case of such coals to investigate carefully claims for subsidy, to ascertain that in fact the coal or coke had been sold as consumer goods.

As this is written the import subsidy on anthracite ranges from \$0.43 on cheaper grades to \$2.58 on the preferred grades. On bituminous coal it ranges from \$0.11 to \$5.00 and averages probably \$1.50 per ton. The return to parity of the Canadian dollar was of some assistance in this connection; at one time the subsidy on imported anthracite ran as high as \$3.94 per ton.

The total amount of import subsidies paid on coal and coke up to March 31, 1946, amounted to \$18,274,588.70. The amounts paid, with approximate related tonnages, under each classification, are as follows:

—	Amounts Paid	Tonnages
	$	
Coal, United Kingdom Anthracite	3,139,380.42	711,000
Coal, United States Anthracite, Consumer	7,314,875.39	16,997,000
Coke, Consumer	776,499.54	2,127,000
Coal, United States, n.o.p. Consumer	7,043,833.35	17,589,000
	18,274,588.70	37,424,000

(7) *The Emergency Coal Production Board; Production Subsidies, Loans and Grants*

This Board, as stated earlier in this chapter, was established by Order in Council P.C. 10674 on November 23, 1942, to take care of a grave situation that was developing in the matter of the supply of coal both for household use and for industry. It was to consist of the Coal Controller as Chairman and two other members, later increased to four, to be responsible under the direction of the Minister, then the Minister of Finance, but later the Minister of Munitions and Supply, "....for the taking of such measures as may be necessary or expedient for maintaining and stimulating the production of Canadian coal and for insuring an adequate and continuous supply thereof for all essential purposes". Under that Order, the Board was empowered to open and operate new coal mines, to prohibit or limit the operation of any existing mine which, in the opinion of the Board, might have insufficient production to warrant the continued employment of labour and equipment, to direct the production policies and methods of any coal mine, to conduct investigations relating to impediments in respect of the mining and distribution of coal, and to suspend for such period as the Board might designate any provision of any law respecting the conditions of employment or eligibility of persons for employment in coal mines where they might constitute impediments to maximum production. It also gave the Board power to require the operator of any coal mine to adopt any production plan or other incentive that might be ordered; and authorized the Board to enter any premises and take possession of any supplies of coal and allocate or dispose of same as the Board might deem proper. The Board was also given the power to enter into possession of and utilize any land, building, or plant or equipment, paying therefor such compensation that might be determined by agreement or by the Exchequer Court. The Board was further empowered to render or procure such financial assistance to any coal mine as the Board might deem proper for the purpose of ensuring the maximum or more efficient operation of such a mine, provided that the assistance, except capital assistance, should not be such as to increase the profits of operation beyond the standard profits as established under the Excess Profits Tax Act.

By amending Order P.C. 4565 on June 4, 1943, the Board was empowered to guarantee, on behalf of the Canadian Government, the repayment of any advance made by any bank to any coal mining operator, if in the opinion of the Board it might facilitate the maximum or more efficient operation of the mine.

From its inception, the Board was concerned with the manpower situation, and while it was empowered to override provincial laws concerning eligibility for employment in coal mines, these powers were not exercised directly. It was, however, largely responsible for the Order in Council, P.C. 4092, of May 17, 1943, dealt with in this chapter under the heading "Manpower for the Mines and Coal Deliveries".

The Board's principal activity was the securing of financial assistance to the industry. At the time the Board was established, one of the principal handicaps to the industry was shortage of working capital. Labour shortages had accentuated this condition as any decrease in production through loss of manpower increased the labour cost of the remaining production. Increases in wages and in other costs had also occurred in many cases. Many mines were in poor financial condition and in some cases were likely to go bankrupt and close down. Any shutdown, even if temporary, would mean that the miners would drift away from this type of employment with a further loss in potential production. The Board considered, therefore, that the first matter to be dealt with was to keep these mines in a sound financial condition. The financial assistance given was of five kinds,—production subsidies, grants, loans, special depreciation and depletion allowances, and wage equalization payments, besides the Board's sponsorship of the strip mine projects in Alberta. They will be dealt with in that order.

(*a*) *Production Subsidies*—The first meetings of the Emergency Coal Production Board early in December 1942, authorized the making of accountable advances to mines known to be in precarious financial position, the payments to be made by Commodity Prices Stabilization Corporation on the recommendation of the Board, and the amounts and terms of payment to be reviewed at least once each three months and based, wherever possible, on audit and inspection reports satisfactory to the Board. It was considered that, save in exceptional cases, financial assistance should be such as to take care of operating losses of the companies together with the amount of their standard profits or 15 cents per net ton, whichever should be the lesser. This practice was followed until March of 1944, assistance being limited to those companies that operated at a loss.

During this period it was found that the policy of guaranteeing losses was not giving sufficient encouragement to the operators to increase production, and gave no incentive to economical operation. It was consequently decided in March 1944, that the existing policy should be replaced by a new plan of subsidy at a flat rate per ton, not to exceed standard profits, the subsidy to cover primarily the added cost imposed on the operators by Government action, such as authorized wage increases, cost of living bonus and other items beyond the control of the operator. It was decided that a maximum rate of subsidy for each area should be fixed based on an investigation of the productivity and financial position of the mines in the area, and to consider individual claims for subsidy within the limits of the maximum rate for the field. The maximum rates were determined as follows:

Nova Scotia	$ 0.65
New Brunswick	1.00
Alberta:	
Edmonton Area	0.65
Drumheller Area	0.30
Camrose Area	0.65
Alberta:	
Lethbridge Area	$ 0.35
Coalspur Area	0.35
Saunders Area	0.50
British Columbia	0.60*

* This being increased on July 1, 1945, to $0.75.

It was also decided that due to the special problems involved with the Dominion Coal Company group in Nova Scotia, the old system should be retained for those specific mines, the costs there to be determined by Government audit.

Each company applying, and found eligible, was authorized for a flat rate subsidy after careful analysis of its financial position. Rates were determined for each fiscal year in advance on the basis of the previous year's experience and approximated the loss for the fiscal period just ended plus 15 cents per ton. If the results in the current year were less favourable, the rate for the next year might be revised within the limits of the maximum for the field. Quarterly statements were required to keep the Board informed of the profit and loss position of the subsidy recipient. If these indicated that the profits were progressing into the excess profits bracket, the rate was not changed during that fiscal period but advances were withheld until the financial result of the year's operations was determined. Fixed rates were maintained for the full fiscal period to encourage the operator to fight cost increases and to maintain a rate of production that would ensure a profit.

Production subsidies actually paid by the Board to March 31, 1946, amounted to $22,721,120.95. Of this sum $18,394,599.47 went to Nova Scotia mines, of which $15,204,505.96 was paid to Dominion Coal Company Limited and $2,474,303.28 to Acadia Coal Company; $819,376.26 was paid to New Brunswick mines; $381,253.54 went to mines in Saskatchewan, of which $242,223.61 was paid to the Manitoba and Saskatchewan Coal Company Limited; $2,195,293.80 was received by operators in Alberta, practically all of which went to operators of mines producing "domestic" coal; and $930,595.88 went to British Columbia mines, including $707,144.33 paid to Canadian Collieries (Dunsmuir) Limited. Further details of these payments may be found in the chapter entitled Financial Aspects of the Industry. The only important Nova Scotia mines not in receipt of a production subsidy were Old Sydney Collieries Limited and Joggins Coal Company Limited. Some of the larger producers of "domestic" coal in Alberta, and practically all of the mines producing industrial coal in the Alberta and British Columbia mountain region have not received this subsidy.

The restriction of the production subsidy to the amount of the "standard profits" did not necessarily mean that the operators received their full standard profits. Many operators showed no profit in spite of subsidy payments, and a great many others obtained profits much below the standard profits as established under the Excess Profits Tax Act.

What might have happened without this assistance is, of course, a matter of conjecture, but it seems obvious that without it, the continued sale of coal under the price ceiling would have severely handicapped a great many producers, and others would doubtless have been obliged to discontinue operations.

Production subsidies, it might be noted, maintained the price ceiling on Canadian produced coal to both domestic and industrial consumers, while the import and domestic subsidies paid through Commodity Prices Stabilization Corporation Limited, generally speaking, applied only to coal for domestic use. No provision was made, however, for production subsidy on tonnage delivered to the Government of Canada, or any agency thereof. Instead, on such sales the Coal Administrator authorized a price increase approximately equivalent to the amount of the subsidy.

The disbursement of such large sums of money was bound to be attended by many difficulties. Close scrutiny of the accounts of each operator was required, and different accounting methods employed by the various operators and differing concepts of capital and income led inevitably to many disputes. The Board was alert to see that the money was used for the purpose for which it was paid, but in spite of close supervision it is possible that some development work and other capital expenditures were paid for by Government money earmarked for operating losses.

Four proceedings have been instituted in the Exchequer Court with respect to the activities of the Board. One by Western Dominion Coal Mines Limited related to the right of an operator to receive subsidy, and resulted in a judgment favourable to the Board. Another brought by Rosedale Collieries Limited related to a direction by the Board to the operator to continue operations in accordance with the recommendations of the Board's engineer. Judgment was given the operator for $38,986.86, being the amount expended to the time the Board advised that it would be responsible for no further expenditures, the claim for work done beyond that time being dismissed. Two other actions, one raising the question whether interest on investments should be included in arriving at the profit position of the mine, and the other involving the right to claim depletion allowance in arriving at the profit position, in the absence of proof that it represented loss of money expended, are still pending in the Exchequer Court.

(b) Grants.—With the object of obtaining quick additional production, a number of grants were made to mine operators in the early days of the Emergency Coal Production Board. Made with no provision for repayment, these grants were chiefly for the purpose of driving new entries, development work, and in the case of strip mines, for additional stripping. Some grants were made, however, for other purposes such as power installations and housing. They totalled $278,814.64, and none was made to Nova Scotia or British Columbia operators. The principal grants were: $66,538.82 to Western Dominion Coal Mines Limited; $39,886.37 to Rosedale Collieries Limited; $70,691.06 to K.D. Collieries Limited; and $40,000.00 to Cadomin Coal Company Limited. While in most cases these grants resulted in additional production, the grant to K.D. Collieries Limited had no tangible results as the grant was made for the specific purpose of opening a new mine which never came into production. In addition to those paid to operators, sundry other grants were made for special purposes, the largest of which was the sum of $62,458.91 given to the Quebec Department of Mines for peat development.

(c) Loans—To provide for capital expenditures involved in procuring additional coal, a total sum of $396,786.11 was advanced by the Board by way of loan prior to March 31, 1946, most of which went to operators in Alberta and Saskatchewan. While power to compromise was given, no compromises have been effected to date. Except for one company, which had a loan of $4,000.00 and has since become bankrupt, all loans are current and the Board expects to recover its advances in practically all cases.

(d) Special Depreciation and Depletion Allowances—In some cases, in order to encourage production, the Emergency Coal Production Board made provision for accelerated depreciation allowances and increased depletion allowances to encourage mine operators to purchase new machinery, or extend plants, or to provide a greater tonnage of coal. The operation of the Excess Profits Tax Act imposed a serious limitation on the expansion of the mine operators' activities for, apart from the difficulty of finding the necessary capital, those concerns best able to do so were reluctant to make expenditures which might not be of value in post-war and lowered-tax days; nor did they wish to deplete their coal reserves when their additional profit represented only additional tax. They were, however, quite prepared to do so if the cost could be written off, or a depletion reserve set up, against surplus profits earned during the period of the 100% Excess Profits Tax. The Minister of National Revenue had, by statute, discretion to fix the amount of depletion and depreciation to be allowed and through the exercise of this discretion, on the recommendation of the Emergency Coal Production Board, accelerated depreciation was granted in a number of instances on such items of capital expenditure as miners' houses, cutting machines, transmission lines and new development work. The normal rates of depreciation ranging from 5 per cent to 10 per cent per annum were increased to percentages ranging from 20 to 33⅓ on new expenditures totalling about three and three-quarter millions of dollars, and it meant to those operators in the excess profits

brackets, that during the period of the 100% tax, the Government absorbed about 80 per cent of the cost of these capital items. It also meant a considerable saving to operators in standard profits, but of course meant nothing to those whose operations resulted in a loss. By far the greater part of these special allowances related to western mines, the most important being an allowance of 20 per cent on a new and modern plant costing about one and a half million dollars built in 1942 by the Crow's Nest Pass Coal Company Limited.

Two bituminous strip mines in the mountain region of Alberta were granted an additional depletion allowance of 15 cents per ton on all coal produced in excess of that produced during the period of standard profits, 1936 to 1939. This resulted in some increase in production and the special depletion allowances given amounted to some four or five thousand dollars in all. One strip mine in the Maritimes was granted a similar allowance. According to information supplied by the Coal Controller, these were the only operators granted special depletion allowances on the recommendation of the Board.

(e) Wage Equalization Payments—Basic wage rates in effect in the Cape Breton and Springhill mines of the Dominion Coal Company, and rates in effect in the mines of Old Sydney Collieries Limited and Acadia Coal Company Limited were at variance. On the establishment of the War Labour Board, applications were made involving changes in the agreements between the three companies and District No. 26 of the United Mine Workers of America. In March, 1942, a report of the Board recommended further negotiations between the companies and the union, suggesting that by joint action some of the differences might be resolved. In the negotiations, it was agreed that a sum of $500,000.00 per year would be made available to the respective companies for the purpose of equalizing the rates paid to the employees of the three companies, distribution of the sum to be as determined by the union and the companies. An independent audit of the companies, authorized by P.C. 13/8817, of November 11, 1941, at the request of the union, disclosed the inability of the companies to pay this sum, and finally the Government agreed to make that amount available annually. Before any of this money was disbursed, a new agreement between the companies and the union, ratified by the War Labour Board on March 19, 1943, resulted in wage increases much in excess of the $500,000.00 mentioned in the prior agreement.

Meanwhile, the Emergency Coal Production Board was established, the duty of taking care of this promised aid was assigned to it, and the sum of $685,699.65 was disbursed to Dominion Coal Company Limited and Acadia Coal Company Limited as a wage equalization subsidy. This wage equalization grant was later discontinued, it being merged in the production subsidy.

(f) Government-Sponsored Strip Mines in Alberta—When the coal situation became particularly serious in the summer of 1943, the Board decided that the best method of obtaining immediate increased production was by opening new strip mines. The Board's engineer surveyed possible locations and recommended the opening of six such mines in the Province of Alberta, the mines to be operated by private companies with the financial assistance of the Board.

The first funds were made available by the Board's guarantee of bank overdrafts for capital expenditures and operating costs. Guarantees were also given to stripping contractors employed by the operators. The initial agreement between the Board and the operators provided that all funds relating to each project should be kept in a separate bank account, and the proceeds of all coal sold should belong to the operator after payment of all operating costs. Arrangements were made for special depletion allowances, but, as none of the mines operated at a profit, it is unnecessary to consider this except to say that a misunderstanding as to the nature of this allowance, some operators considering it as equivalent to a royalty payable as part of the operating costs, was the cause of considerable difficulty, leading in one case to a protracted investigation. Operations under the agreement were to be continued for so long only as the Board might determine and under the general direction and control of the Board.

Operation of these mines was suspended early in 1944 when the demand for coal had eased, but due to the closing of some underground mines in Alberta, and an anticipated shortage of coal in the coming winter, they were re-opened late in June under new agreements providing for payment by the Board of bank overdrafts; and the supply of funds thereafter was made by the Board to the special accounts on the basis of a monthly budget prepared by the operator, and certified by the Board's representative. A progressive audit by the Treasury Department was designed to ensure that funds were spent in accordance with the approved budget. Receipts from coal sales were thereafter paid by each operator into another special account, and paid out each month to the Board for application, first, on all indebtedness for capital expenditure, and secondly, on the advances made for operation. The agreements provided that on abandonment of the project, or termination of the contract by the Board, the Board would assume all operating deficits, and if any money should be still owing for capital expenditures, the operator should have the option of surrendering title to the capital equipment, or taking title thereto on payment of the balance due. All credit sales had to be approved by the Board.

On February 20, 1946, the Board authorized the termination of all contracts, the equipment purchased and paid for by capital loans and retired by receipts from coal sales reverting to the operators, except in one case where the capital advances had not been repaid, and the operator exercised the option of surrendering the equipment which was declared surplus to the War Assets Corporation.

These operations resulted in a net loss to the Government of approximately $1,400,000.00 and the tonnage sold by the projects during the period they were sponsored by the Board amounted to 852,711 tons. Overburden totalling 7,277,012 cubic yards was removed at stripping costs ranging from $.217 to $.29 per cubic yard. The advances unrecovered, the overburden removed, the amount of coal sold, and the portion thereof shipped into Ontario on the freight subvention of $2.50 per ton, are shown as follows by projects:

Project	Total Advances Unrecovered as at March 31, 1946	Cubic Yards Overburden Removed	Tonnage Sold to March 31, 1946	Tonnage Shipped to Ontario to End of 1945
	$			
Camrose Collieries Ltd	335,808.92	948,314	87,681	Nil
Castor Creek Collieries Ltd	185,425.15	284,800	53,498	Nil
Birnwel Coal Limited	152,701.28	2,244,775	352,492	75,718
Majestic Mines Limited	189,033.53	827,994	57,227	3,905
Western Ventures Ltd	353,572.52	1,405,854	142,059	27,464
Continental Coal Corp., Ltd	504,553.27	1,565,275	159,754	47,597
Total	1,721,094.67	7,277,012	852,711	154,684

While at first glance it might appear that these costs were excessive, and no doubt unexpected delays occurred and mistakes were made, almost inevitable in handling a new venture of this nature, it should be remembered that these were emergency measures necessitated by the inadequate output of the ordinary domestic mines. It should also be remembered that in order not to conflict unduly with the established mines in Alberta, the strip mines operated only on part time, and solely during emergent periods when the demand could not be met from regular sources, and this naturally resulted in higher operation cost and consequent loss. These strip mines materially assisted in preventing distress in western Canada, and the tonnage shipped into Ontario was of assistance in meeting the shortage there.

(8) *The Hamilton Coke Ovens*

Due to increased industrial activity in the Hamilton area, the demand for gas increased from around ten billion to about thirteen billion cubic feet per year. Some natural gas fields became exhausted and to obtain additional sources of gas, the Power Controller arranged for the installation of new facilities and compelled many householders to convert from gas to coal. As one means of taking care of the shortage, a new Curran-Knowles coke oven gas plant was erected at Hamilton. Thirty-six of these ovens were completed in the spring of 1943 and an additional eighteen in December of that year. The plant, built on leased land, was constructed at a cost to the Government of $4,100,000. Operated by Hamilton By-Product Coke Ovens Limited, a company with existing ovens at Hamilton, who purchased the gas and sold the coke for the Government, the operating losses amounted at the end of June 1946 to $1,400,000. Recently, the demand for gas having fallen off but, there being need for coke for domestic heating, the Coal Controller has taken over the plant and its operation is being continued on his behalf. It is currently operating at a monthly loss of from $30,000 to $50,000. To June 30, 1946, 470,000 tons of coke had been produced at an operating cost of $13.13 per ton, not allowing for the retirement of the capital invested. It is proposed that this plant will be scrapped as soon as the present coal emergency is over. The scrap value is expected to be about $250,000.

While the Government will probably take a loss of approximately $6,000,000 on this enterprise, it was a plant built for the specific purpose of keeping in operation the industrial plants in the Hamilton area and on that ground might be justified.

Conclusion

From the commencement of the war to March 31, 1946, the Federal Government has paid by way of assumption of losses, direct subsidies and grants to persons engaged in the coal business in Canada, in excess of $50,000,000.00, most of this having been paid after the price freezing order of November 1, 1941. Of this, about $32,000,000 was paid in respect of coal and coke produced in Canada, and the balance with respect to imported coal and coke. This is, of course, exclusive of amounts spent by way of administration costs of Coal Administration, Coal Control and the Emergency Coal Production Board, amounting to $795,768.27, the cost of the coal conservation advertising program amounting to $220,781.57, the cost of general advertising by Coal Control of $112,512.46 and payments by the Federal Government indirectly related to coal, such as the cost of building and the loss on operation of the coke ovens at Hamilton, and the cost of building the Koppers ovens for the Algoma Steel Corporation, which, while built for the steel industry, did supply a great deal of coke for domestic use. It also excludes the subventions and payments under the Domestic Fuel Act and the Coal Bounties Act which cannot be termed wartime expenditures, and which are dealt with elsewhere in this report.

Undoubtedly a substantial part of this money was spent in support of the policy of price stabilization, and large sums are still being disbursed to this end. It is, of course, a matter for speculation as to what might have resulted if consumers had not been protected by a price ceiling and the operators had been left free to secure the price that the coal would have otherwise commanded. The policy of price stabilization was no doubt in the public interest, but, in

parting with the subject, it is pertinent to observe that there may be a tendency on the part of industry to let down when a necessary incident of stabilization is payment from the Federal Treasury of the losses that are sustained in operation.

The subsidies paid to coal mine operators, being inseparably involved with the ceiling price, frequently placed the producer in an unrealistic and unfair light as to the efficiency of his operations. He is shown as receiving substantial aid from the Government, while his customer, protected by the price ceiling, may be operating at profit levels never before attained.

However, we have now arrived at the time when consideration has to be given to the relaxation of controls. It was thought that as far as coal was concerned, the controls could be abandoned on March 31, 1946, but strikes in the United States bituminous fields and other factors made it appear that the controls were probably more necessary than ever through the winter of 1946-47. Nevertheless, the situation is that present coal prices, by reason of increases in wages and in other costs, are permanently up, and the time cannot long be delayed until these increased costs of a permanent nature are passed on to the consuming public. When this is done, the coal industry will again be placed in the position of finding its own market, with all the incentives that are implied therewith.

The foregoing review, particularly in connection with subsidies paid the Canadian industry, is some indication of the underlying weakness of the industry in Canada which, troubled with over-production in one decade, encounters difficulty in meeting the demands of increased production in the next.

CHAPTER XIII

SUBVENTIONS AND OTHER AIDS

This chapter treats with the assistance extended to Canadian coal producers by the Dominion Government by payments of money and by customs duties. In the chapter Government in Relation to the Coal Industry the interest of the Dominion Government in matters pertaining to coal supply and coal production, starting with World War I, is reviewed, and is here alluded to only briefly. In 1921 a Special Committee of the House of Commons inquired into a variety of matters pertaining to Canadian coal supply, the availabliity of ample supplies of anthracite for Central Canada being a principal matter of concern, and resulted in the creation of the Dominion Fuel Board, a body charged with the study of Canada's fuel problem. In 1923, a Committee of the House of Commons, and another Committee of the Senate inquired into matters pertaining to coal, including the feasibility of increased use in Central Canada of coal produced in the Maritimes and Western Canada. On March 31, 1924, the following resolution was passed by the House of Commons:

> "That in the opinion of this House, the time has arrived for Canada to have a National Policy in relation to its coal supply and that no part of Canada should be left dependent on the United States for such supply. The Government should immediately consider the institution of an all British and Canadian coal supply, and that such a policy is both a social and economic necessity and in the best interests of the future of Canada."

Then, in 1926, a Special Committee of the House of Commons recommended, amongst other things, that trial shipments of Alberta domestic coal be made by rail and lake under the supervision of the Dominion Fuel Board, and that the Government consider the question of granting assistance to enlarge markets for Maritime coal. The Board of Railway Commissioners was directed to ascertain and report on the cost of carrying coal from Alberta mines to points in Ontario, and the majority of the Board found that the inclusive cost of transporting coal to Toronto, including an element of profit, was $12.20 per ton. In the same connection the Board of Railway Commissioners, on February 1, 1933, certified to the Minister of Mines that for test movements between 1928 and 1932 the railways were entitled to full tariff rates, namely, $10.90 a ton to North Bay, and $12.70 a ton to Toronto, from Alberta mines.

Growing out of the attention directed to Canadian coal supply in the late 1920's and early 1930's, and of the various test movements carried out, and also of the contraction in coal markets in the early 1930's, a system of Federal aid to enlarge the markets for Canadian coal developed. The assistance was generally known as transportation subventions. The purpose of these subventions was to equalize the competitive position of Canadian coals with respect to imported coals in various areas, principally Central Canada. The actual methods used varied from year to year, from area to area, and with the nature of the consumer, but in general the Federal Government contributed the approximate difference in laid-down costs of Canadian coal and the imported coal that might otherwise have been used. Among the methods adopted to achieve this end were the following:

(1) Paying on individual movements the difference between the laid-down cost of Canadian coal and the laid-down cost of imported coal that might otherwise have been used,

(2) Reducing the freight rate by paying the carrier a fraction of a cent per ton-mile,

(3) Reducing the freight rate by paying the carrier a percentage of the rate,

(4) Paying $2.50 per ton on an $8.00 rate offered by the railways for the movement of Alberta coal into Central Canada.

In respect of railway purchases the assistance given was the difference in laid-down costs as determined by the Dominion Fuel Board. In the calculation of the assistance the operators' selling price (not the cost of production) was taken, and the laid-down cost of United States coal that might otherwise have been used was ascertained by advice from purchasing executives of the railways, and checked by inquiries in the trade, and by reference to published prices at various producing points. In the case of subventions which were a reduction in the freight rate, the extent of the reduction was fixed by Order in Council after the Dominion Fuel Board had determined the competitive position of Canadian and imported coal. In every case there was a ceiling varying from 50 cents to $2.50 per ton. As the competitive position varied from time to time, it was necessary almost annually to issue new Orders in Council adjusting the reduction granted in the freight rate. There was no way whereby the competitive position of Canadian coal with imported coal could be equalized with complete accuracy. It would appear that over a period of years and in a general way the competitive position was equalized, but there are a number of instances where the assistance was either too great or too small. Details of the various Orders in Council may be found in Coal Statistics for Canada.

From 1931, assistance was extended under Orders in Council to a producer on Vancouver Island for coal exported or used for bunkerage. The assistance was not, strictly speaking, a transportation subvention.

We will now proceed to review Federal assistance under three headings, assistance by Orders in Council (Subventions), assistance under two Statutes, and assistance by customs tariff.

ASSISTANCE BY ORDERS IN COUNCIL (SUBVENTIONS)

NOVA SCOTIA

Starting in May of 1931, P.C. 1300 provided for the assisted movement of Nova Scotia coal to points in the Provinces of Quebec and Ontario. Under the prevailing conditions, water-borne Nova Scotia coal could be laid down at St. Lawrence ports to compete with imported coal, and to enable furtherance from these ports by rail assistance was granted by a reduction from existing rates varying from one-fifth cent per ton per mile to one-third cent per ton per mile, the maximum assistance being $1.50 per ton. In addition, coal shipped wholly by rail to points in the Provinces of Quebec and Ontario during the period from November to April inclusive, was granted a reduction of one-seventh cent per ton per mile, the maximum assistance being $2.00 per ton. In all cases the amount of the assistance was payable to the railways. In May of 1932, by P.C. 1048, this scheme of assisting furtherance was confirmed, and coal purchased by railways for their own use at points in Quebec and Ontario was granted assistance to the extent of the difference between the laid-down cost to the railways of coal mined in the Maritime Provinces and the laid-down cost of the imported coal that would otherwise be used, up to a maximum of $2.00 per ton, payable to the coal operators. Provision was also made for assistance when coal was furthered by water transportation west of Montreal.

The assistance thus reviewed was greatly altered by the impact of war, when coal in the Maritime Provinces ceased to move into Ontario, and shipments to Quebec were greatly reduced. Orders in Council provided for movements of Nova Scotia coal within Nova Scotia and to the Province of New Brunswick

and also altered the terms on which assistance was granted on movements to the Province of Quebec. To a great extent this assistance was for the protection of the consumer under the wartime price ceiling policy, which should be recognized in any consideration of this period.

Particulars of transportation assistance, including amounts disbursed for test movements, are given in the following table:

ASSISTANCE EXTENDED FOR MOVEMENT OF NOVA SCOTIA COAL
1928 TO 1944 INCLUSIVE

Year	Tons	Cost	Cost Per Ton
		$	$
1928	113,905.00	65,600.38	0.58
1929	304,276.00	205,270.16	0.67
1930	372,029.00	214,720.41	0.58
1931	401,597.00	225,137.08	0.56
1932	710,449.00	545,944.30	0.77
1933	1,384,268.00	1,280,222.84	0.92
1934	1,748,004.00	1,687,450.78	0.97
1935	1,588,302.00	1,489,412.37	0.94
1936	1,677,096.00	1,572,780.24	0.94
1937	1,908,821.00	1,785,791.70	0.94
1938	1,377,115.00	1,253,313.26	0.91
1939	2,420,694.00	2,988,403.66	1.23
1940	1,940,571.00	2,643,366.54	1.36
1941	2,015,829.00	2,188,364.52	1.09
1942	1,655,264.00	2,710,437.79	1.64
1943	803,892.00	2,310,513.26	2.87
1944	798,258.45	1,932,798.71	2.42
	21,220,370.45	25,099,528.00	1.18

Included in the foregoing amounts are payments made under Order in Council P.C. 944, April 26, 1932, authorizing payment to Canadian coal operators of the difference per ton between the laid-down cost to the coke oven proprietor or gas manufacturer of coal mined in Canada and the laid-down cost at the same plant of the imported fuel which would otherwise be used, up to a maximum of $1.00 per ton. Under this Order in Council Nova Scotia coal, in limited amounts, moved to the Ottawa Gas Company Limited and Shawinigan Chemicals Limited, but the only important tonnage was delivered to the Montreal Coke and Manufacturing Company, particulars whereof may be of interest, and are as follows:

MONTREAL COKE AND MANUFACTURING COMPANY

Calendar Year	Canadian Coal Moved	Amount Paid
	Net tons	$
1932	151,194.75	151,194.75
1933	67,844.00	67,844.00
1934	188,278.45	188,278.45
1935	175,669.30	175,669.30
1936	163,427.40	163,427.40
1937	171,489.75	171,489.75
1938	171,222.15	171,222.15
1939	182,697.70	182,697.70
1940	179,928.75	179,928.75
1941	146,368.00	117,094.40
1942	30,951.75	30,951.75
1943	Nil	Nil
1944	Nil	Nil
	1,629,072.00	1,599,798.40

A breakdown of the tonnages moved under assistance into Quebec and Ontario should be noted:

TONNAGES AND COSTS OF NOVA SCOTIA COAL MOVED UNDER SUBVENTION

Year	Into Quebec		Into Ontario	
	Tons	Cost	Tons	Cost
		$		$
1928	72,124.00	56,954.96	41,781.00	8,645.42
1929	219,618.00	189,093.73	84,658.00	16,176.43
1930	277,318.00	197,735.35	94,711.00	16,985.06
1931	303,083.00	203,416.70	98,514.00	21,720.38
1932	521,587.00	425,022.84	188,864.00	120,921.46
1933	915,364.00	591,845.92	468,904.00	688,376.92
1934	999,821.00	718,363.44	748,183.00	969,087.34
1935	711,732.00	461,872.12	876,570.00	1,027,540.25
1936	640,749.00	396,777.35	1,036,347.00	1,176,002.89
1937	825,555.00	497,348.40	1,083,266.00	1,288,443.30
1938	687,622.00	443,528.74	689,493.00	809,784.52
1939	1,016,522.00	656,435.46	1,404,172.00	2,331,968.20
1940	1,209,352.00	1,473,806.03	731,218.00	1,169,560.51
1941	1,815,479.00	1,934,541.44	200,350.00	253,823.08
1942	1,393,946.00	2,076,861.67	......	......
1943	453,284.09	853,431.26	......	......
1944	333,429.03	710,170.97	......	......
	12,396,585.12	11,887,206.38	7,747,031.00	9,899,035.76

During the entire period under review, a total of 20,354,094 tons of Nova Scotia coal reached the Quebec market without assistance. The highest annual tonnage was in 1928, amounting to 2,638,127 tons, and from 1934 onwards always exceeded 1,000,000 tons annually until the war disrupted water-borne movement up the St. Lawrence. In the years 1942 to 1944 inclusive, 424,394 tons of coal moved within the Province of Nova Scotia under subvention, at a total cost of $1,048,505.48; and for the same period 652,360.42 tons were moved into New Brunswick under subvention, at a total cost of $2,264,780.38.

A summary of the amounts disbursed for the assisted movement of Nova Scotia coal is as follows:

Coal moved into Ontario	$ 9,899,035.76
Coal moved into Quebec	11,887,206.38
Coal moved within Nova Scotia and to New Brunswick	3,313,285.86
	$25,099,528.00

NEW BRUNSWICK

Concurrently with granting assistance for the movement of Nova Scotia coal, assistance was also granted encouraging the rail movement to Quebec of coal mined in New Brunswick. With New Brunswick production being limited, the tonnages moved and payments made thereon were relatively small.

TONNAGES AND COSTS OF NEW BRUNSWICK COAL MOVED UNDER SUBVENTION

Year	Tons	Cost	Cost Per Ton
		$	$
1928	120	209.78	1.75
1929	231	330.12	1.43
1930	36	70.20	1.95
1931	239	162.49	0.68
1932	1,195	896.13	0.75
1933	1,163	980.78	0.84
1934	10,196	8,609.22	0.84
1935	14,325	10,544.29	0.74
1936	20,889	15,314.14	0.73
1937	41,083	32,362.55	0.79
1938	32,305	23,455.94	0.73
1939	54,165	45,663.98	0.84
1940	59,224	42,385.65	0.71
1941	43,783	31,226.06	0.71
1942	6,627	5,202.20	0.79
1943	5,268	4,292.61	0.81
1944	2,111	1,623.16	0.77
	292,960	223,329.30	0.76

ALBERTA AND EASTERN BRITISH COLUMBIA

During World War I Alberta "domestic" coals, from the Drumheller and other fields, displaced imported coals in the Manitoba market, but at that time little headway was made by the western bituminous producers in displacing United States bituminous coal. The bituminous operators in Alberta and Eastern British Columbia felt that with some reduction in freight rates they could compete successfully in this market. In 1930 the first Orders in Council designed to help bituminous coal of Alberta and eastern British Columbia to gain access to the Manitoba market were promulgated, granting a reduction in the freight rate. The assistance was limited to coal used for industrial purposes. In 1930 the reduction was one-eighth of a cent per ton per mile; in 1931, one-seventh of a cent per ton per mile, with a maximum of $1.50 per ton; in 1932 the maximum was reduced to $1.20; and in 1934 the assistance was fixed at one-twelfth of a cent per ton per mile, with a maximum of 70 cents. Also during the period from 1930 forward, various Orders in Council provided assistance for coal used by the railways at points, roughly speaking, east of Manitoba. Herewith table giving particulars of this assistance:

TONNAGES AND COSTS OF ALBERTA AND BRITISH COLUMBIA CROWSNEST COAL MOVED UNDER SUBVENTION TO MANITOBA AND HEAD OF THE LAKES AREA

Year	Tons	Cost	Cost Per Ton
		$	$
1930	55,474.00	60,298.84	1.09
1931	180,990.00	212,539.31	1.17
1932	218,668.00	273,574.36	1.25
1933	229,204.00	288,263.92	1.26
1934	268,297.00	316,151.45	1.18
1935	274,971.00	299,411.25	1.09
1936	298,602.00	307,104.93	1.03
1937	268,544.00	285,556.08	1.06
1938	258,718.00	257,890.81	1.00
1939	436,092.00	579,132.24	1.33
1940	585,276.00	1,033,864.51	1.77
1941	865,335.00	1,492,150.55	1.72
1942	609,183.00	909,134.25	1.49
1943	116,684.00	102,709.35	0.88
1944	62,830.57	64,483.85	1.03
	4,728,968.57	6,482,265.70	1.37

There is another type of assistance open to both "domestic" and "steam" coal destined for Ontario points where the freight rate is $8.00 a ton or more. In 1933 conferences took place between the railways and the Federal Government, resulting in the railways offering a flat rate of $8.00 to all points in Ontario where the existing rate equalled or exceeded that figure, provided the Government paid a flat subvention of $2.50 a ton, which would make the freight rate to the consumer $5.50 a ton; and accordingly P.C. 740, of April 24, 1933, was issued, carrying this into effect. This Order in Council was principally designed to encourage the regular movement of "domestic" coal into Ontario. The table following furnishes particulars of this assistance:

TONNAGES AND COSTS OF ALBERTA AND BRITISH COLUMBIA CROWSNEST COAL MOVED TO ONTARIO UNDER FLAT RATE SUBVENTION

Year	Tons	Cost	Cost Per Ton
		$	$
1928	32,101.00	191,323.57	5.96
1929	37,115.00	213,136.73	5.74
1930	33,049.00	188,008.81	5.69
1931	23,483.00	127,565.55	5.43
1932	19,116.00	97,340.87	5.09
1933	30,531.00	76,326.11	2.50
1934	54,868.00	137,172.22	2.50
1935	63,802.00	159,506.81	2.50
1936	65,229.00	163,075.77	2.50
1937	55,277.00	138,195.80	2.50
1938	64,056.00	160,144.80	2.50
1939	92,207.00	230,523.66	2.50
1940	154,737.00	386,850.13	2.50
1941	272,643.00	681,622.04	2.50
1942	270,100.00	675,268.42	2.50
1943*	(−110.00)	(−273.93)	2.50
1944*	84.00	210.85	2.50
	1,268,288.00	3,625,998.21	2.86

* Adjustments for previous years

The figures from 1928 to 1932 inclusive include amounts disbursed in connection with test movements to Ontario.

The tonnages moved from 1940 to 1942 are in a considerable measure explained by short supply and wartime demand. In the latter part of 1942 the Coal Controller prohibited shipments to Ontario, but they were resumed in 1945. The flat rate of $8.00 is still in force. Since 1940 under P.C. 944, already mentioned, bituminous coal for coking has moved with assistance to the Winnipeg Electric Company; the sums paid, included in the first tabulation, are:

WINNIPEG ELECTRIC COMPANY

Calendar Year	Canadian Coal Moved	Amount Paid
	Net Tons	$
1940	50,875.59	31,486.88
1941	68,850.02	26,348.76
1942	71,246.73	21,096.90
1943	61,774.30	18,532.31
1944	36,473.26	10,941.97
	289,219.90	108,406.82

Commencing in 1942 the movement of coal from Alberta to British Columbia was extended assistance in the amount of 65 cents per ton. This was due to wartime conditions and the price ceiling. Particulars are:

Year	Tonnage	Amount
		$
1942	4,835	3,142.54
1943	101,880	72,075.70
1944	116,818	75,934.31
	232,533	151,152.55

A summary of the assistance extended to the movement of Alberta and Eastern British Columbia coal is as follows:

Movement of coal from Alberta and eastern British Columbia east (Manitoba and Head-of-the-Lakes area)	$ 6,482,265.70
Movement of coal from Alberta and eastern British Columbia (Flat rate to Ontario)	3,625,998.21
Movement of coal from Alberta and eastern British Columbia to British Columbia	151,152.55
	$10,259,416.46

SASKATCHEWAN

Saskatchewan producers of lignite coal are in an advantageous position with respect to the Manitoba market. Consequently, when assistance was given bituminous coal moving into Manitoba for industrial use, it was necessary to grant assistance to the Saskatchewan producers so that their various advantages, geographical and otherwise, would not be destroyed. Orders in Council also provided for assistance in the case of Saskatchewan coal moving eastwards in the area between Manitoba and the Head-of-the-Lakes.

Particulars of the amounts paid annually in respect of movement of Saskatchewan coal are as follows:

TONNAGES AND COSTS OF SASKATCHEWAN COAL MOVED UNDER SUBVENTION

Year	Tons	Cost	Cost Per Ton
		$	$
1930	19,604.00	9,802.82	0.50
1931	60,477.00	27,060.87	0.45
1932	100,479.00	40,698.22	0.41
1933	130,966.00	54,085.12	0.41
1934	144,228.00	42,128.51	0.29
1935	138,584.00	32,251.99	0.23
1936	146,894.00	38,135.52	0.26
1937	163,970.00	38,031.88	0.23
1938	145,615.00	33,759.96	0.23
1939	159,340.00	37,592.44	0.24
1940	41,256.00	25,949.43	0.63
1941	22,677.00	21,840.05	0.96
1942	13,649.00	13,144.46	0.96
1943	10,963.00	10,535.17	0.96
1944	16,027.00	15,376.91	0.96
	1,314,729.00	440,393.35	0.33

BRITISH COLUMBIA EXPORT AND BUNKERING ASSISTANCE

In view of the assisted movement of Alberta and Maritime coal commencing in 1928, the tariff imposed early in 1931 on the importation of United States anthracite and coke, the increase in the tariff on the importation of United States bituminous coal, and the continuing competition of fuel oil, an appeal was made for assistance on coal exported to foreign countries, and used for ships' stores. As a result, Order in Council P.C. 1302, of May 30, 1931, extended financial assistance of 25 cents per ton to coal producers, and to coal distributors of coal mined in British Columbia and sold as fuel for ships' stores for ocean-going vessels and/or for export to foreign countries other than the United States of America. By Order in Council P.C. 2699, of October 27, 1931, the assistance payable on coal sold for ships' stores was increased to 50 cents per ton, and on coal exported other than to the United States to $1.00 per ton. Then on May 28, 1934, by Order in Council P.C. 1122, the assistance on coal sold for ships' stores in excess of 60,000 tons was increased to $1.00 per ton; and finally, on December 5, 1939, by P.C. 3971, assistance on all coal sold for ships' stores was fixed at 75 cents per ton. Particulars of payments are as follows:

TONNAGES AND COSTS OF BRITISH COLUMBIA COAL SOLD FOR EXPORT OR BUNKERING

Year	Tons	Cost	Cost Per Ton
		$	$
1931	66,130.00	21,058.70	0.32
1932	99,340.00	44,652.13	0.45
1933	79,584.00	35,528.62	0.45
1934	98,419.00	46,590.63	0.47
1935	102,493.00	67,261.46	0.66
1936	143,324.00	113,324.14	0.79
1937	199,650.00	169,650.21	0.85
1938	152,727.00	122,726.79	0.80
1939	241,083.00	211,083.28	0.88
1940	227,227.00	183,173.57	0.81
1941	98,701.00	74,025.83	0.75
1942	138,734.00	104,050.71	0.75
1943	44,309.00	33,232.02	0.75
1944	34,940.00	26,204.62	0.75
	1,726,661.00	1,252,562.71	0.73

The only producer benefiting under the foregoing Orders was Canadian Collieries (Dunsmuir) Limited, all of whose mines are located on Vancouver Island. Inland mines could not compete and take advantage of this assistance due to the cost of taking the coal to tidewater.

GENERAL EFFECT OF SUBVENTIONS

The economic results of the assistance thus far reviewed are difficult to evaluate. Prior to the recession of trade in the 1930's, the Canadian coal industry was in a relatively sound position, and the primary effect of subventions was to lessen the severity of the depression. Some coal produced and sold would not have been mined but for the expansion of markets effected by this assistance, but it is unsafe to conclude that all coal moved under assistance would necessarily have been without a market. It may, however, be assumed that some measure of employment was created by this assistance, that increased tonnages at the mines had the effect of spreading operators' costs, and that Canadian railways, particularly on movements from the West, benefited by the scheme.

ASSISTANCE BY STATUTE

There are two statutory measures which encourage the use of Canadian coal, the Domestic Fuel Act, 1927, Chapter 52, and an Act to place Canadian Coal used in the Manufacture of Iron or Steel on a Basis of Equality with Imported Coal, Chapter 6, 1930.

DOMESTIC FUEL ACT, 1927

This Act authorized the Minister of Mines to enter into an agreement for a period not exceeding fifteen years for the construction of coke plants where at least 70 per cent of the coal used would be produced in Canada, the Government agreeing to pay annually the owners of such plants 4 per cent in the case of individuals, and 5 per cent in the case of municipalities, of the cost of construction, the net sum payable to any owner in any year not to exceed $1.00 per ton of Canadian coals used in the production of coke for domestic use. Three companies took advantage of this Act.

Nova Scotia Light and Power Company Limited

The contract with the Government was dated April 1, 1928. The total cost of construction was $300,492.02. From 1929 to 1944 inclusive the plant used 120,029.30 tons of coal. The total subsidy for this tonnage amounted to $117,481.28.

Quebec Power Company

The contract with the Government was dated April 15, 1930. The total cost of construction was $608,029.88. From 1929 to 1944 inclusive, the plant used 172,696.91 tons of coal. The total subsidy was $172,696.91.

B.C. Electric, Power and Gas Company

The contract with the Government was dated June 30, 1932. The total cost of construction was $1,832,881.82. From 1932 to 1944 inclusive, the plant used 341,935.54 tons of coal, and the total subsidy paid was $341,935.54.

Total Assistance

Nova Scotia Light and Power Co. Ltd.	$ 117,481.28
Quebec Power Company	172,696.91
British Columbia Electric, Power and Gas Company	341,935.54
	$ 632,113.73

AN ACT TO PLACE CANADIAN COAL USED IN THE MANUFACTURE OF IRON OR STEEL ON A BASIS OF EQUALITY WITH IMPORTED COAL

This was an Act to implement one of the recommendations of the Royal Commission on Maritime Claims, and provided that so long as the provisions of Tariff Item No. 1019 in Schedule B to the Customs Tariff, permitting a 99 per cent drawback on coal used for making steel, remained in effect, the Government would pay to the manufacturers of iron or steel 49.5 cents per ton on bituminous coal mined in Canada and converted into coke and used by the manufacturer in the smelting in Canada of iron from ore, or in the manufacture in Canada of

steel ingots and steel castings. No company entitled to a drawback under the above tariff item was entitled to the bounty. The only manufacturer qualifying for benefits under this Act was the Dominion Steel and Coal Corporation Limited.

The total payments made thereunder are as follows:

Fiscal Year	Approximate Net Tons of Coal	Amount Paid
		$
1930–1931	273,148	135,209.23
1931–1932	126,356	62,546.18
1932–1933	118,783	58,797.54
1933–1934	213,841	105,851.40
1934–1935	336,849	166,740.20
1935–1936	390,168	193,133.12
1936–1937	564,695	279,523.96
1937–1938	583,817	288,989.41
1938–1939	369,434	182,869.80
1939–1940	605,909	299,924.93
1940–1941	776,969	384,599.64
1941–1942	765,775	379,058.59
1942–1943	766,144	379,241.26
1943–1944	646,875	320,203.10
1944–1945	709,071	351,000.04
	7,247,834	3,587,688.40

SUMMARY

Having now reviewed the assistance extended the coal industry by Order in Council and Statute, there follows a summary thereof for the years 1928 to 1944 inclusive:

—	Tons	Amount
Assistance by Order in Council		$
1. Nova Scotia coal	21,220,370	25,099,528.00
2. New Brunswick coal	292,960	223,329.30
3. Alberta and Eastern British Columbia coal	6,229,790	10,259,416.46
4. Saskatchewan coal	1,314,729	440,393 35
5. British Columbia Export and Bunkering Assistance	1,726,659	1,252,562.71
	30,784,508	37,275,229.82
Assistance by Statute		
6. Domestic Fuel Act (1927) Chapter 52	634,660	632,113.73
7. Coke Bounties Act	7,247,834	3,587,688.40
Total	38,667,002	41,495,031.95

ASSISTANCE BY CUSTOMS TARIFF

Tariffs have been a factor in protecting the Canadian coal producer, and while minor adjustments have been made from time to time, basic changes in the tariffs have been few, and are summarized in the following table covering the

period from 1867 to the present. The table shows the principal tariff rates applicable to coal and coke from the United States and the United Kingdom, imports from other countries being relatively negligible.

CANADIAN CUSTOMS TARIFFS

Cents per Net Ton

—	Anthracite		Bituminous		Coke		Lignite	
1867–1869	Free		Free		Free		....	
1870	50		50		50		....	
1871–1878	Free		Free		Free		....	
1879	50		50		50		....	
1880–1886	50		60		50		....	
1887–1896	Free		60		50		....	
1897–1906	Free		53		Free		....	
	U.K.	U.S.	U.K.	U.S.	U.K.	U.S.	U.K.	U.S.
1907–1922	Free	Free	35	53	Free	Free	....	....
1923–1924	Free	Free	35	53	Free	Free	Free	Free
1925–1930	Free	Free	35	50	Free	Free	Free	Free
1931	Free	40	35	75	Free	$1.00	Free	Free
1932–1939	Free	50	35	75	Free	1.00	Free	Free
1940	Free	50	Free	75	Free	1.00	Free	Free

The Dominion Government has derived substantial revenues from the duties collected on coal and coke. These revenues, including excise taxes but less drawbacks, for the fiscal years 1928-1929 to 1944-1945 were as follows:

Fiscal Year	Total Net Revenue	Fiscal Year	Total Net Revenue
	$		$
1928–29	5,630,152	1937–38	9,304,937
1929–30	5,747,931	1938–39	8,087,713
1930–31	5,322,330	1939–40	8,350,871
1931–32	7,288,935	1940–41	13,504,953
1932–33	6,492,316	1941–42	19,812,160
1933–34	7,439,142	1942–43	21,376,151
1934–35	8,678,754	1943–44	26,424,926
1935–36	7,849,809	1944–45	25,060,971
1936–37	8,722,263		

It is widely accepted that the central parts of Canada have received relatively greater benefits than the eastern and western sections from the Canadian policy of protective tariffs. In the case of the coal tariff, however, the benefits have gone solely to the eastern and western sections. The history of Canadian coal tariffs has been closely associated with the Nova Scotia producing industry. The major changes in the tariffs on bituminous coal were primarily made to assist the marketing of Nova Scotia coal. Based on the periods when these changes were made, a concise history of the various tariff rates imposed from time to time follows.

1867–1878

The first tariff on imported coal was in 1870, when 50 cents per ton was imposed on coal and coke. The duty was removed the following year, in view of protests from consumers in the Provinces of Quebec and Ontario.

1879–1898

In 1879, as a part of the policy designed to encourage the growth of Canadian industry, a tariff of 50 cents per ton was imposed on all imported coal and coke.

In the following year the tariff on bituminous coal was increased to 60 cents, and coke used for manufacturing was placed on the free list. These tariffs were designed to encourage the marketing of Nova Scotia coal in Ontario and Quebec and originally enabled Nova Scotia coal to be sold in competition with United States bituminous at least as far west as Toronto. In 1878, before these tariffs were applied, sales of Nova Scotia coal in Ontario and Quebec totalled 94,000 tons. By 1898 sales had increased to 600,000 tons, or about 40 per cent of total sales of Nova Scotia coal. In 1887 the tariff on anthracite was removed, and in 1894 coke was placed on the free list. In 1897 slack coal was separately classified under a duty of 20 per cent ad valorem, not to exceed 13 cents per ton. The duty on bituminous was reduced from 60 cents to 53 cents in the same year.

1898–1931

In 1898 Canada introduced its British preferential tariff policy, the preference consisting of a remission of 25 per cent of the duty; this was increased to 33.33 per cent in 1900. In 1904 specific rates were established in place of remissions, and in 1907 the tariff schedules known as British preferential, intermediate and general were established. The establishment of British preferential rates was not accompanied by any changes in the duties applicable to coal imported from the United States. The duty on bituminous slack was made specific at 14 cents per ton, and the duty on other grades of bituminous remained at 53 cents. Anthracite and coke continued on the free list. During and immediately following World War I an additional excise duty of 7.5 per cent (5 per cent under British preference) was applied to imports of bituminous coal and coke, but not to anthracite coal. This excise tax was in effect from 1915 to 1919. Lignite coal was first separately classified in 1923 and placed on the free list. Bituminous slack ceased to have a separate classification, and in 1925 all bituminous was included in one item of 50 cents per ton.

1931–1939

In 1931 the tariff on bituminous coal was increased from 50 cents to 75 cents, excepting the case of British preferential tariffs, where the 35 cent rate continued to apply. This increase appears to have been necessary in order to maintain the competitive position of Nova Scotia coal. The imposition in 1931 of a 40 cent per ton duty on American anthracite (increased in 1932 to 50 cents) while anthracite imported from the United Kingdom remained free, influenced a shift in a large portion of the anthracite trade from the United States to Great Britain. Before the inception of this preference American anthracite predominated in the Canadian market, but with the assistance of the tariff British anthracite captured a very substantial portion of the sales, but lost practically the whole market during World War II.

It has been mentioned that during World War I an excise tax of 7.5 per cent ad valorem was placed on the importation of bituminous coal and coke for a few years. In 1931, with the need to increase Federal revenues, an excise tax of 1 per cent was imposed on all imports by a special revenue act. This tax was raised to 3 per cent in 1932 and, insofar as coal was concerned, applied to the duty-paid value at the mine. While this tax may have been applied as a means of raising revenue, it had the same effect as an equivalent increase in the tariff rates insofar as protection was concerned. In 1934 the excise tax was reduced to 1.5 per cent and in 1935 entirely removed from goods entering Canada under British preference. The 3 per cent excise tax was removed in respect of imports from United States under the 1939 trade treaty.

1939–1946

In June, 1940, a 10 per cent war exchange tax was placed on goods imported into Canada other than under the British preferential tariffs. In December of the same year, under the War Exchange Conservation Act, the tariff was removed

from British bituminous. In January, 1942, the war exchange tax and the 50 cent duty were removed from water-borne American anthracite entering the ports of the Maritime Provinces. In 1942 the war exchange tax and the duty on American coke imported into Canada for some purposes were removed. The war exchange tax was removed from imports of anthracite in January, 1945, and finally, about five months later, the tax was removed from all imports of coal and coke.

TARIFF DRAWBACKS

Prior to 1931, while coke was admitted to Canada free of duty, there was a tariff on United States bituminous coal. In 1907 Canadian manufacturers using imported coal for making coke were relieved of this anomaly by the enactment of Tariff Item 1019, which provided a drawback of 99 per cent of the duty paid on bituminous coal imported by proprietors of coke ovens for manufacture into coke for use in the smelting of metals from ores. With slight modification, this item has remained in force until the present. The tonnages involved under this item increased from less than 500,000 annually to about 750,000 tons annually during the 1930's. During World War II this figure increased to over two million tons per year. Tariff Item 1049 introduced in 1925 provided for a drawback of 99 per cent on bituminous coal imported by proprietors of by-product recovery coke ovens and converted into coke at their ovens. This item was revised in 1934 and again in 1935. At present it provides a drawback of 50 per cent of the duty paid on imported bituminous coal converted into coke to be sold, and 99 per cent if 35 per cent of the coal used was mined in Canada. The item was introduced at a time when an alternative for United States anthracite was being sought. In the 1930's tonnages qualifying for this drawback were on the average in excess of one million tons per year, but the volume declined substantially during the early years of World War II, increasing somewhat quite recently. Other drawback items have been provided for bituminous coal imported for special purposes, but the tonnage concerned seldom exceeded 60,000 tons in any year.

TARIFF IN TERMS OF LAID-DOWN COST

While the tariff of 75 cents on bituminous coal may appear substantial in relation to the cost f.o.b. mine, for comparison with tariffs on other commodities it should be measured in terms of the laid-down cost. At the present time, taking a typical United States bituminous coal, the mine cost might be $3.00 per ton, but with transportation charges the laid-down cost, without tariff, at, say Toronto, might be $6.00 Consideration of laid-down cost is particularly important in the case of coal because the transportation costs normally make up a substantial portion of the cost to the consumer.

OTHER COUNTRIES

Government assistance has been given to the coal industries of many countries including Germany, Poland, France, Belgium, Czechoslovakia, Spain, the United Kingdom and the Union of South Africa, and has taken various forms, including payments to support wages, subsidized exports, customs duties and subnormal freight rates. Within the last twenty years the coal industry in the United States has received practically no direct financial assistance or indirect assistance by customs tariffs.

CHAPTER XIV

RECOMMENDATIONS

By THE CHAIRMAN AND MR. JUSTICE McLAURIN

In the preceding chapters we have examined in some detail the supply and use of coal in Canada. In the course of that examination we have made a number of suggestions concerning a variety of matters. It is now our intention to review the outstanding features of the Canadian coal market, and make some specific recommendations concerning Canadian coal policy.

Canadian Coal Market

From coal is obtained about three-quarters of the energy used in the Maritimes, about one-half of that used in central Canada and on the Prairies, and about one-third of that used in British Columbia. The alternative sources of energy, in order of importance for Canada as a whole, are water power, petroleum, wood fuel and natural gas. These alternative sources have a considerable effect on the market for coal; in part their use is complementary to that of coal, but generally they compete with coal. Except for the railways, most of the mechanical energy requirements of Canadian industry are supplied by water power. Hydro electricity is particularly important in the Provinces of Ontario and Quebec, and accounts for the location of many industries in that area. There is probably no comparable area on the North American continent in which water power is as important a source of energy. Despite the importance of alternative sources of energy, coal is, and will probably continue to be, the most important source of energy for railway locomotives and for industrial and domestic heating.

Compared with the use of coal as a source of energy its use by the chemical industry as a raw material is very small. There is no likelihood that a large synthetic liquid fuel industry based on coal will develop in the next few years.

The consumption of coal in Canada has varied over the last twenty years from less than 25,000,000 tons annually in the early 1930's, to nearly 45,000,000 tons annually during World War II. The consumption in any one year has depended very largely upon the level of economic activity. Details of coal consumption by regions for 1937 and 1945 are presented in the following table. The year 1937 is considered to be typical of the pre-war period; the year 1945 is the most recent year for which figures are available. Coal consumption in the immediate future is expected to be somewhat less than in 1945, but substantially greater than in 1937. The figures below are in net tons.

COAL CONSUMPTION IN CANADA

—	Total	Canadian	Imported	Exports of Canadian Coal
1937				
Maritimes	4,400,000	4,200,000	200,000	200,000
Ontario and Quebec	18,400,000	3,700,000	14,700,000	....
Prairies	6,100,000	6,000,000	100,000	200,000
British Columbia	1,500,000	1,500,000	....	
	30,400,000	15,400,000	15,000,000	400,000
1945				
Maritimes	5,900,000	5,000,000	900,000	500,000
Ontario and Quebec	26,800,000	800,000	26,000,000	....
Prairies	8,900,000	7,900,000	1,000,000	400,000
British Columbia	1,900,000	1,900,000	....	
	43,500,000	15,600,000	27,900,000	900,000

Coal production in Canada has varied over the last twenty years from less than 12,000,000 tons annually in the early 1930's, to nearly 19,000,000 tons annually in the early years of World War II. The variation in production from year to year has been greatly influenced by variations in coal requirements. Fluctuation over the years in the demand for coal has presented a major problem to Canadian coal producers. The problem of stabilizing the market for coal is very much the same as that of stabilizing the level of employment in all industries, and, while the solution of that problem would be of great benefit to the Canadian coal industry, it is a problem much wider than the scope of our inquiry.

The production of coal in Canada is limited to Nova Scotia and New Brunswick in the East, and to Saskatchewan, Alberta and British Columbia in the West. There is no coal produced in the central part of Canada. The volume of Canadian production is divided more or less equally between eastern and western mines. Maritime mines supply the requirements of the Maritimes and have normally found an outlet for about three million tons in central Canada. Western mines have normally supplied coal requirements of the four western provinces and less than one million tons annually has found an outlet in Ontario, principally for locomotive use. Most of the coal used in central Canada has been imported from the United States. A major question has been the extent to which both eastern and western Canadian coal should be assisted to enable it to move into Ontario and Quebec. It is therefore relevant to consider the factors which have determined the extent to which Canadian coal has entered this market.

Maritime coal marketed in central Canada is mainly waterborne. Western coal reaching the same market is carried entirely by rail. The level of vessel rates for Nova Scotia coal has been such that in terms of transportation costs this coal has been at an advantage over coal imported from the United States. This advantage is off-set to some extent by seasonal navigation on the St. Lawrence river, which imposes its pattern in the operation of mines in Cape Breton. This situation is partially met by stock-piling at the mines during the winter. The western coal producer is at a disadvantage in terms of transportation costs throughout almost the whole of central Canada. The extended rail movement necessary to market western Canadian coal in Ontario and Quebec presents a serious obstacle to the expansion of that movement.

Cost of mining coal in Canada is on the whole higher than the cost of mining comparable coal in the United States. Coal prices f.o.b. mines illustrate the point. In 1939 the f.o.b. mine price of Cape Breton slack coal was approximately $3.50 per ton. The f.o.b. mine price of comparable slack at various United States mines supplying Canada was about $1.25 per ton. Since 1939 mining costs in Cape Breton have risen sharply. In the Fall of 1946 the mining cost of Cape Breton slack was about $7.00 a ton, while the price of comparable slack at United States mines shipping to central Canada was about $3.00. Though bituminous mine prices in western Canada are somewhat higher than United States mine prices, the differential in price is not itself a material factor. The United States mines supplying Canada have taken advantage of favourable physical conditions to mechanize extensively and produce at low cost. Physical conditions in the Canadian mining areas, with few exceptions, are much less favourable. In contrast to the flat lying seams and shallow land cover in United States mines, operations in Nova Scotia are chiefly in undulating seams at depth and submarine. Many of the bituminous mines in Alberta work steeply pitching seams. In the Prairie mines physical conditions are more favourable, but seasonal variations in demand prejudice low cost operation.

Almost all coal produced in the Maritimes is high volatile bituminous, with a relatively low ash fusion temperature and high sulphur content. While a satisfactory fuel for nearly all industrial purposes including locomotive use, it is

not entirely acceptable in central Canada for domestic use or for some special industrial purposes. The use of New Brunswick coal is restricted by its high ash content. Western high volatile bituminous is a satisfactory fuel for locomotive and industrial use, comparing favourably with competitive United States fuels. Low volatile bituminous coal of a type generally acceptable for domestic use is mined in the west, but has a tendency to excessive friability. Because of its low calorific value, the market for lignite coal is limited. Much of the "domestic" coal mined in Alberta is a suitable fuel for household use but does not store too well in the open. This circumstance largely accounts for the small amount of this coal that has moved into central Canada even with Federal assistance.

Coal Policy in the Past

The coal policy of the Federal Government has been to assist the marketing of Canadian coals in central Canada. Almost continuously since 1879 there have been tariffs against imported coals. At the present time for coals imported from the United States the duty is 75 cents per ton on bituminous and 50 cents per ton on anthracite. Under the British preference United Kingdom anthracite enters free. The tariff assisted Nova Scotia coal to develop a market in the St. Lawrence Valley. The tariff has also assisted western coal to develop and maintain its market as far East as Winnipeg. In the early 1920's there was considerable concern in Ontario as to the adequacy of anthracite supplies, which stimulated an interest in the feasibility of the movement of Canadian coal to central Canada. Test movements of coal from both the West and the Maritimes were undertaken, with the then Board of Railway Commissioners charged with the duty of determining transportation costs, and their ultimate findings indicated that the railways were entitled to published tariff rates for their transportation services. These rates were too high to permit the movement of much coal. With the commencement of the depression and contraction of coal markets, the Federal Government initiated a policy of assistance commonly termed "transportation subventions". The aid was designed to equalize laid-down costs of Canadian coal with United States coal, and thereby assist the furtherance of Canadian coals to some portions of central Canada. In addition, the Federal Government and the railways agreed upon a flat rate of $8.00 per ton, with a Federal subvention of $2.50 for the movement of western coals eastward. This special rate was designed primarily to assist the movement of "domestic" coal to Ontario. There was also some assistance given to one operator in British Columbia on coal exported other than to the United States, and on coal delivered for ships' stores. The assistance was administered by the Dominion Fuel Board, and during the middle and late 1930's approximately 1,750,000 tons of Nova Scotia coal and 650,000 tons of western coal were assisted annually at a cost in each case of approximately $1.00 per ton, or an average annual cost to the Federal Treasury of about $2,400,000. Although substantial quantities of bituminous coal moved under subvention, the amount of "domestic" coal from western Canada reaching the market in central Canada during these years never exceeded 65,000 tons annually.

With the increased demand for coal during World War II control of supply was necessary in both the United States and Canada. The Emergency Coal Production Board disbursed substantial amounts to Canadian mines as production subsidies for the purpose of maintaining or increasing coal production. The production subsidies to March 31, 1946, amounted to $22,700,000, of which $3,500,000 was paid to western mines and $19,200,000 to eastern mines. We wish to emphasize that the foregoing payments cannot be separated from the Government policy of price control. However, if the level of productivity had been maintained in Cape Breton, the production subsidies that were paid would have been much smaller.

Coal Policy in the Future

It has often been advocated that the Federal coal policy should be to make Canada independent of foreign countries for its coal supply. To achieve independence at the 1945 level of consumption, Canadian mines would have to produce 43,000,000 tons of coal annually, an increase of 27,000,000 tons over their production in 1945. Maritime production in 1945 was about 5,500,000 tons, and the highest production achieved by these mines during the past twenty years was less than 8,500,000 tons a year. It is our opinion that Maritime production of from 7,000,000 to 8,000,000 tons annually could be attained, but a production in excess of 10,000,000 tons would be extremely difficult to achieve. Assuming Maritime production could make available for central Canada 5,000,000 tons of coal, which is unlikely, it would be necessary to provide over 20,000,000 tons from western sources. From the point of view of coal reserves, this is feasible. The cost of moving the coal, however, would be very large, and the laid-down cost of the coal in central Canada would be far in excess of that of imported coal. On the average the laid-down cost would be in the neighborhood of $5.00 a ton more than that of imported coal. Assuming an $8.00 freight rate for western coal, and making an allowance for the increased cost of moving a larger tonnage of Nova Scotia coal, the total additional cost of self-sufficiency would be at least $100,000,000 annually. Independence may be physically possible, but it is too impractical to merit further attention. Central Canada must therefore continue to rely mainly on United States sources of supply.

The impracticality of fully supplying central Canada with Canadian coal does not preclude the movement of some Canadian coal into the market with assistance. It is our view that the coal industry, both in the East and the West, is entitled to some assistance in addition to that provided by present tariff provisions to move Canadian coal into Ontario and Quebec. Having regard to the advantages accruing to Ontario and Quebec under Canada's fiscal policy, assistance to the coal industry in addition to the present tariff is only fair. Moreover, coal mining occupies an important place in the economies of a number of Canadian provinces. Conditions in Nova Scotia would have been much worse than they were during the 1930's if a market for some of its coal had not been provided by transportation subventions. At least 100,000 people are dependent, directly or indirectly, on Nova Scotia coal production; without aid additional to the present tariff the industry will be unable to support that number, with resulting social and economic dislocation. Some dislocation in other coal areas in Canada must also be anticipated if additional assistance is not provided. Furthermore, it is in the national interest to encourage as widespread a distribution of industry as the natural resources of the country will permit. This is particularly true in Canada in view of its geographical characteristics and its scattered populated areas. Finally, the maintenance of a reasonable level of production in Canadian mines may be of special value during periods of emergency.

A combination of transportation subventions and the prevailing tariff is a reasonable means of extending assistance. This combination is preferable to an increase in the existing tariff. An increase in the tariff would widen the market for Canadian coal, but would cause an increase in the price of coal in Central Canada. Aid by subventions avoids an increase in coal prices. Another alternative to subventions is the continuation of production subsidies such as proved necessary during World War II. One disadvantage of such subsidies is that they give assistance to the marketing of coal in areas where the coal would be competitive without assistance. A further disadvantage of subsidies as they were necessarily administered during the war is that high cost producers receive most of the assistance and some producers receive none. As already emphasized, production subsidies are inseparably connected with the policy of price control. We feel that they should be withdrawn completely upon abandonment of price

control. In the light of this review we therefore recommend that aid to the coal industry, in addition to that provided by the present tariff, should in the future be given through transportation subventions.

The question then arises as to how much subvention aid should be given to Canadian coal producers. It is our view that the assistance extended during the 1930's was reasonable, and in recommending a continuation of transportation subventions we urge that assistance must bear a reasonable relationship to the cost per ton of the imported coal that would otherwise be used. Subvention assistance announced as a permanent policy by the Government should materially help progressive coal producers to secure markets in central Canada. In western Canada this policy should result in an advantageous movement of bituminous coal into Ontario for locomotive and industrial purposes. The assistance provided "domestic" producers under the flat freight rate with a subvention of $2.50 is, in our opinion, about as much as is reasonable. In 1939 waterborne coal from Nova Scotia reached Montreal without assistance at a slightly competitive advantage over imported coal, but with the present high production costs in Cape Breton, and the high cost of transportation up the St. Lawrence, Cape Breton coal at present appears to be at a grave competitive disadvantage in Montreal. It is not our intention to suggest that transportation subventions should be available to aid the recapture of the markets which, prior to the war, were supplied by Nova Scotia producers without assistance. Operators throughout Canada should not be encouraged to rely on subventions if improved methods of production will lower costs. With the necessary contribution from both management and labour there is no adequate reason why the Nova Scotia mines should not recapture the Montreal market without subvention assistance. The principal operators in Nova Scotia propose extended mechanization and predict that in many mines it will raise productivity above the pre-war level. The proposed improvements are overdue. The improvements contemplated will involve a very susbtantial capital outlay, and the operators, if they are to avoid further Government regulation, cannot look for Government assistance in this connection. If present capital proves inadequate, the security holders themselves must make sacrifices. The union advocated nationalization of Cape Breton mines, principally on the ground that operations would then be more efficiently conducted. The evidence submitted to us fell far short of establishing that nationalization would result in higher productivity.

It is not generally practical to fix subvention aid by statute because the assistance must vary from time to time with changes in the competitive situation. It is exceedingly important that any aid extended should be attended by scrutiny of the efficiency of operations. The fixing of appropriate conditions and the administering of assistance is an assignment of considerable responsibility. Up to the present transportation subventions have been administered by the Dominion Fuel Board, comprised of members of the Civil Service who are more or less occupied with other important duties. We feel that the effectiveness of the Dominion Fuel Board has been limited by the other demands on its members. Accordingly we recommend that a Statutory Board be created with a full-time chairman to keep Canada's energy requirements under continuous review and to advise upon and administer transportation subventions.

Respectfully submitted,

W. F. CARROLL,
Chairman.

C. C. McLAURIN,
Commissioner.

OTTAWA,
December 14, 1946.

Supplementary Note

I think that it may be necessary to afford the Cape Breton mines interim support immediately following the suspension of production subsidies arising out of price control. It may be that, even with the necessary co-operation between management and labour, there will be a short period when, although the productivity of the mines is rising, it will be insufficient to make the coal competitive in the Montreal market. If the productivity of these mines is showing reasonable improvement and if the security holders have made substantial sacrifices and the coal remains non-competitive in the Montreal market, I am of the opinion that the Dominion Government should provide temporary assistance notwithstanding the foregoing observations on subventions and subsidies.

W. F. CARROLL,
Chairman.

By COMMISSIONER ANGUS J. MORRISON

The problems of coal mining in Canada—physical, financial, marketing and labour and management problems—are long standing and fundamental. To ensure the maintenance of such units of the industry as will assure adequate supplies in the areas served or to be served, permit of expansion of production in time of national need, and guarantee these units of the industry being maintained in a healthy financial condition and with ability to pay such wages as will attract and hold labour in the industry, positive action is needed. When the Royal Commission on Coal was created, the war had aggravated the difficulties under which coal mining has been carried on in Canada. It was clearly recognized however that the war had only brought into sharper focus long-term problems, the solution of which cannot be achieved by minor adjustments in policy or organization by the Government or by those in the industry alone.

I do not feel that the review of coal mining in Canada contained in the chapters of the report, and the recommendations based thereon, constitute an adequate approach or are sufficiently basic to place Canadian coal mining upon a sound economic foundation.

To offer practical suggestions and report upon "the problems of, and matters pertaining to, the coal industry in Canada" as directed by the Order in Council appointing the Royal Commission on Coal, I am therefore presenting my views and recommendations on steps needed to establish coal mining in Canada on a sound basis.

Before stating my recommendations, it is essential to point out (as made clear in the main body of this report) that it is not realistic to speak of the coal mining industry of Canada as if it were one industry. There are several different coal mining industries, geographically separated by thousands of miles. Even within one area there are major divisions in the industry by type of coal produced. Each area and each type of coal presents distinct problems, requiring different solutions. The industry as a whole is also made up of many individual and separate entities that have little cohesion. It is necessary to develop not one, but several series of recommendations, to meet these separate series of problems.

There is perhaps only one thing which the various sections of the coal mining industry of Canada have shared in common—the limited extent of their markets close at hand, and their great distances from the principal Canadian markets in Ontario and Quebec as compared with competing United States coalfields, requiring varying degrees of public assistance in marketing. The Dominion Government must continue to have a direct financial interest in coal mining and marketing if these industries are even to continue on their present basis; and in some cases a much greater interest if they are to be placed in a

sound financial position, providing continuity of profitable employment for both management and labour and continuity of supply of this essential raw material for Canadian industrial and domestic use.

The extent of the existing financial interest of the Dominion is, I am sure, not generally realized. Indeed, I feel safe in saying that until the work done by this Commission, a comprehensive picture of the financial assistance extended to coal mining was not available. Unfortunately a complete picture does not exist even now, since the forms of financial assistance have been so varied and complicated that it has been difficult to compile accurate figures on total assistance. For two examples only, the Dominion Treasury has in the last twenty years alone paid out approximately $40,000,000 in transportation subventions of various types, and almost $4,000,000 in bonuses on the use of Canadian coal for coke for steelmaking. These examples do not include the special wartime subsidies related to the maintenance of price ceilings, and to stimulate production, or various minor peacetime disbursements. By far the greatest proportion of these expenditures has been for the support of coal mining in Nova Scotia, but all areas of Canada have drawn upon the Dominion Treasury.

Obviously a government financial interest of this magnitude requires adequate protection, both in administration and in the management of the operations receiving the benefit. Operations substantially supported by public funds cannot be regarded as purely of private concern in all other respects. My first recommendation, therefore, is the establishment of a Board under which can be centralized all forms of financial assistance rendered by the Dominion to the coal mining industries of Canada, and through which Dominion Government policies respecting coal mining and marketing can be administered. Only by the establishment of one central agency of this nature can a clear picture be obtained of the position of the coal mining industry, and adequate steps be taken both to assist the industry and to protect the public interest.

Such an organization does not exist at the present time: the existence for the past twenty-five years of a body entitled "The Dominion Fuel Board", which although originally conceived along fairly broad lines has in latter years been primarily the supervising body for distributing one form of financial assistance, should not be allowed to lead to the belief that a body of the nature I suggest is already available.

The exact form of organization of such a Board, and the functions which it should fulfill, are a matter of importance, which must be dealt with in some detail. To appreciate many of the points which I shall make in connection with the organization and functions of this Board it is necessary first to proceed with comments on the present forms of financial assistance extended by the Dominion Government, the problems of the regional coal industries of Canada and the steps which are necessary to solve these problems. I will therefore proceed to deal with these matters before going into the constitution of the Canadian Coal Board.

The separate coal mining industries of Canada can be roughly divided as follows:

(1) Nova Scotia—New Brunswick.
(2) Alberta (with British Columbia Crowsnest) "steam" coal mines.
(3) Alberta "domestic" coal mines.
(4) Saskatchewan.
(5) Vancouver Island.

Financial assistance has been extended by the Dominion to coal mining in all of these areas. In Saskatchewan, Alberta and eastern British Columbia, assistance has been almost entirely in the form of transportation subventions to enlarge the market area in which Canadian coals could compete with imported supplies. There has, however, in these areas been some assistance given by

way of subsidies for the purpose of keeping mines in operation when coal was in short supply. In Nova Scotia, New Brunswick and Vancouver Island, in addition to subvention assistance, large sums have been provided by the Dominion Government as subsidies and in other forms to permit the companies concerned to continue in operation.

Under all counts, whether of production efficiency, expansion of markets or labour-management relations, the situation in the Province of Nova Scotia is much worse than in any other part of Canada. Extraordinary steps are required if the Nova Scotia mines are to be put into any reasonably competitive position in relation to other sources of supply. Before dealing with the Nova Scotia problems, therefore, I shall review the situation in the other areas, where the industry has dealt with its problems with some appreciable success.

Alberta (including British Columbia Crowsnest) Steam Coal Mines

The "steam" coal mines of the Province of Alberta, together with the British Columbia side of the Crowsnest Pass field, form a major unit of the Canadian coal industry, its production in recent years having been in the neighbourhood of 5,000,000 tons per annum, or between a third and a quarter of total Canadian production. Generally speaking, the technical factors affecting production are favourable, mining methods modern, financial position strong, and productivity of the labour force high by Canadian standards. The major problem in connection with these mines relates to marketing, and the approach to this is simplified by the fact that 75 per cent of the output normally goes to two large purchasers, namely the Canadian Pacific Railway Company and the Canadian National Railways.

The principal difficulty of operators and men alike is achievement of a relatively stable level of operations instead of violent fluctuations through peaks and depressions which have characterized this industry in the past. In the Prairie Provinces coal, like practically all other business, is tied closely to an agricultural economy which has been subject to great fluctuations. The volume of rail freight and in consequence demands by the railways for coal will continue to fluctuate in accordance with such factors as the size of crops and the value of farm products, but it is not necessary for these fluctuations to be allowed to govern the continuity of employment of the thousands of men dependent for their livelihood upon mining railway coal.

This difficulty would be largely met if the railways would co-operate with the industry by planning purchases on a long-term basis, equalizing these purchases as far as possible over a period of years, taking care of short-run variations in their requirements by additions to or deductions from stock piles. This would involve some additional handling charges but against this, however, must be offset the saving in production costs which could be achieved if the mines were able to plan their operations at a more constant level. If the railways were persuaded or required to even out their purchases, more efficient equipment for the stock-piling of coal could be installed, so that the addition to handling charges need be by no means as great as figures which have sometimes been quoted on the basis of present loading facilities.

The exact costs that would be involved in a purchasing policy by the railroads to achieve these ends require further detailed study and are a subject not covered adequately by this Commission. I am convinced however that such extra costs would prove to be relatively slight. Consideration must be given to the added capital cost of stocking excessive amounts of coal through successive lean crop years. If it were thought unreasonable to ask the railroads to assume this additional burden, while the offsetting benefits would accrue to the mine operators and labour, government support of .the same nature as that now extended to promote the stability of marketing of agricultural products should be granted.

While in the greater part of the market now served by the Alberta steam coal mines the Canadian coal holds a natural cost advantage over imported coal, a proportion of the market which they have enjoyed is in areas where their position is marginal and demand for the Canadian coals made effective only through the assistance of transportation subventions.

Attention is drawn to the need for assurance that the subvention policy as laid down will not be rendered inoperative as far as the western mines are concerned by payment of all available funds to assist movements in other parts of the country, merely because the other claims are presented first. As long as it is considered in the public interest that transportation subventions shall be available to ensure the competitive position of the western steam coal mines over a given area, adequate funds to carry out this policy must be ensured. It has frequently been found in the past that, although subventions were theoretically available, when the western operators came to apply the funds provided for subventions had already been exhausted.

There have also been frequent changes in subvention policy from year to year; in any event they have been maintained on a short-term yearly basis. The disadvantages of this lack of stability are obvious. The absence of a firm long-term government policy prevents the operators from planning ahead; there is also a natural reluctance on the part of consumers in subvention areas to draw upon sources of supply which are made uncertain from year to year by changes in government policy. The policy of subvention assistance should apply alike to railways and industrial consumers of western steam coal.

Alberta Domestic Coal Mines

Those Alberta mines producing what are loosely described as "domestic" coals face an entirely different set of circumstances to those applying to the steam coal mines. Whereas the bulk of steam coal output goes to two large customers, domestic coal output is spread among thousands of customers. It is therefore not possible to approach marketing problems, and the production problems directly related thereto, on a basis of negotiations with a few large consumers as in the case of the steam coal mines.

Like the steam coal mines, the domestic fields are tied to the agricultural economy of the Prairie Provinces, so that demand varies according to crop conditions and the resultant ability of the western population to purchase coal. Variable winter weather conditions also affect domestic coal consumption. In addition to these variations from year to year, there is a great seasonal fluctuation in demand. Mines must be organized with capacity to serve peak demands. Many of the domestic coals cannot be stored in the open for long periods, because of deterioration and the danger of spontaneous combustion. This makes it necessary that the mines operate on the basis of producing only sufficient to fill current orders. Normally, prior to the later war years, the domestic mines have operated for only six to eight months in the year, practically closing down from early February until about the middle of July. The high cost of maintaining productive capacity, sufficient to meet peak demands, in idleness through these months has frequently made the return on the capital in the industry insufficient from the viewpoint of returns to investors, and insufficient to enable adequate investment in modern machinery. The mine workers must seek other employment in this idle season or be the recipients of government relief, and this is not only objectionable from their point of view, but disrupts the efficiency of the mining force. The primary problem of the domestic mines is to find marketing and distribution techniques which will reduce the heavy seasonal fluctuation normally existing.

As in the case of the western steam coals, over most of the Prairie Provinces domestic coals can be marketed with a natural cost advantage in relation to imported coal supplies. To enlarge the market area for Alberta domestic coals, however, transportation subventions are essential.

It appears unlikely that the buying habits of the Prairie consumers of Alberta domestic coals could be sufficiently changed to permit the operation of the mines on a stable annual basis, as contrasted with the heavy seasonal variations of the past. The problem is therefore one of finding a new market for Alberta domestic coals which will take its coal during the present slack season of February to July. Such a potential market does exist, and could be directed to the Alberta domestic coals at comparatively slight expense. This market is in northwestern Ontario, which is outside the competitive area of the Alberta domestic producers under present transportation subvention arrangements. In this area, served at the present time from United States mines, storage facilities are already available for storage of the western coals, the time taken for transportation providing in itself part of the covered "storage" required. If the demands of this area were diverted to the Alberta domestic mines, the time lag between production and delivery would be such that the demands would fall upon the Alberta mines during the present slack season and the coal be received approximately at the season when this area is now accustomed and finds it necessary to receive supplies. There need be no dislocation in the buying habits of the consumers.

It is recognized that the demand from this area would probably not be sufficient to continue mining operations in the Alberta domestic mines in the February to July season at the same level at which they must now operate during the other months of the year to meet demands from their major markets. The northwestern Ontario demand would, however, enable the Alberta domestic mines to maintain a sufficient volume of production to justify keeping the mines in operation where in the past they have closed down and laid off their staff except maintenance men. With this assurance of the practicability of maintaining production, the producers could in turn co-operate by concentrating their development work in the February to July period, thus further minimizing the present seasonal peaks and depressions, producing more stable employment conditions and reducing production cost per ton by regularity of operation.

It is suggested that to achieve these desirable ends the transportation subvention policy be extended to enable the marketing of Alberta domestic coal competitively in northwestern Ontario, and that these subventions be made available on a seasonal basis to ensure placing these new production demands on the mines during the season when they are now largely closed down. It would appear desirable to set up a central selling agency to keep distribution costs to a minimum; this however should be the responsibility of the operators who have coals suitable for shipment into this market.

The benefit of these measures would accrue principally to the Drumheller, Lethbridge, Coalspur and Saunders fields.

The Edmonton field does not ship any substantial proportion of its output to the Saskatchewan or Manitoba markets. Stabilizing of operations in this field therefore depends upon developing year-round demand in the area now served by these coals.

Saskatchewan

The nature of the coal produced in the Saskatchewan field is such that this industry is not adapted to seeking markets beyond the area which it is now serving, namely southern Saskatchewan and Manitoba.

There has been a remarkable growth in Saskatchewan production in recent years, achieved through increasingly efficient production methods, and an effective campaign to educate potential consumers in the technique of using lignite coals. Generally speaking, the coal mining industry of Saskatchewan can be said to be on as sound a basis as any of the coal mining industries in Canada.

Vancouver Island

Production of the Vancouver Island fields has declined steadily for the past twenty years. The major factor in decline of demand for Vancouver Island coals has been competition offered by oil, which has won former export markets and entered into the home market, both in industrial and domestic consumption. Bunkerage demands have largely fallen off due to the same competition.

It must be recognized also however that the problems of the Vancouver Island fields are to a considerable measure production problems. Mining conditions are more difficult than in any other part of Canada. The exhaustion of the most favourable seams and areas has increased their engineering problems, and inevitably increased their costs.

Dominion Government assistance already extended to Vancouver Island mines includes production subsidies, subsidies on coal delivered for ships' bunkerage, and subsidies designed to promote the use of Vancouver Island coals in coke production.

To the extent to which it might be decided as a matter of national policy that production from Vancouver Island fields should be maintained, it would appear that there is little remedy that can be found other than through continuation and extension of public assistance, either in the form of subsidies or protective policies designed to reduce competition offered by imported oil. It must be recognized however that the effectiveness of such policies would be limited, in that it is outside the power of the Canadian Government to restore the export and bunkerage markets for coal which formerly existed.

It must be remembered that the Vancouver Island coal field played a very important part in the war emergency, and that it still is the only coalfield on the Pacific Coast that has available facilities and supplies for taking care of Pacific demands. From the standpoint of security in a national emergency, Vancouver Island has assumed a new importance; during the war years excellent bunkering facilities were provided, not only for the handling of their own product but also for the shipment of coal brought in from the Mountain regions of Alberta and British Columbia.

New Brunswick

Although New Brunswick coal production constitutes only about two per cent of total output of coal in Canada this production is of importance to the market that it serves. This market has been limited almost entirely to local use within New Brunswick, and production has not been greatly affected by changes in tariffs or introduction of transportation subventions. The principal users of New Brunswick coal have been the railways, the pulp and paper industry and power plants.

Mining operations have been subject to severe fluctuations, with numerous small producers whose operations are intermittent.

The problem of the New Brunswick coal producers is not to develop new markets, due to the limited reserves, but to hold the markets that they have now. New Brunswick coal stands in relation to Nova Scotia coal in very much the same position that Nova Scotia coal stands in relation to supplies imported from the United States. There are few areas in which it holds any advantage over Nova Scotia coal other than that which has been given in the past by a price differential related to production costs. This price differential was to a considerable extent based upon lower wage scales and has largely disappeared within the last few years.

Due to the physical conditions of the coal seams, cleaning of the coal at the face does not produce a satisfactory product, and while it is appreciated that the financial position of the many small companies does not warrant their under-

taking heavy capital expenditures, I would suggest that thought should be given to the setting up of a central cleaning and preparation plant to improve the product and its competitive position.

Nova Scotia

While there are other operators, the coal mining industry of Nova Scotia consists mainly of the operations of subsidiaries of the Dominion Steel and Coal Corporation.

The problems of the Nova Scotia coal mining industry are more serious than those of the industry in any other part of Canada. In addition, the Dominion Government is more directly concerned with the Nova Scotia coal mining industry, from the viewpoint of public finance, in that the degree of public assistance to the Nova Scotia operators is far greater and more direct in character than in any other part of Canada.

Prior to the War Federal financial assistance to coal mining in Nova Scotia was substantially the same in nature as that extended to coal mining in other parts of Canada, namely transportation subventions to extend the market area in which the Canadian coal could compete with imported coals. There were some other forms of assistance available in the pre-war years. An Act of 1930, for example, provided for payment of a bonus on Canadian coal converted to coke and used in the manufacture of iron and steel. This was a measure authorized by Act of Parliament which, while theoretically available to promote the use of Canadian coal from all sources, was in effect of assistance to the operations of Dominion Steel and Coal Corporation alone, and has bonused this Corporation to the extent of some $4,000,000 since 1930 for using coal produced by its own subsidiaries. This and other measures are discussed more fully in the following section on Financial Assistance.

The most important feature of Dominion assistance to the coal mining industry of Nova Scotia is one which has developed during the war years. Under the stress of wartime conditions, coal mining in Nova Scotia would not only have failed to meet the demands of the Canadian economy upon it but would probably have collapsed had it not been for greatly increased Federal financial aid in a variety of forms. This Commission is concerned with the future of the coal mining industry of Canada, not with a review of wartime measures made necessary to meet emergency and exceptional conditions. The significance of the special wartime assistance to Nova Scotia operators, however, is that it appears impossible that this assistance can be terminated within any short period of time without a collapse of production and employment. It appears unlikely that the industry can even return to its pre-war position without major changes in organization.

It must be recognized that the immediate pre-war position of the coal mining industry in Nova Scotia was precarious. The industry had suffered from a long period of decline, the peak of production having been reached over thirty years ago. While transportation subventions had given marginal assistance to the coal mining industries of other parts of Canada, in the case of Nova Scotia they were of much greater importance. Over 25 per cent of the coal produced in the last five pre-war years was marketed only with subvention assistance—34 per cent in 1939. To say that labour relations have been poor would be an understatement. Productivity is now lower than in any other Canadian field and much lower than in competitive U.S. fields, and production costs are correspondingly high. A combination of poor labour relations and antiquated production methods (with the possible exception of Old Sydney Collieries) had brought the industry to a point where it appears safe to say that it would have been at the point of collapse within a very few years; wartime pressure merely speeded up the process of disintegration already under way.

The coal industry of Nova Scotia is of primary importance in the industrial life of that Province, and particularly so when account is taken of the steel industry of Nova Scotia which is directly dependent upon it. So large a segment of the industrial economy of the Province and the country cannot be allowed to collapse—or to be temporarily prevented from financial collapse only at the expense of the working force and of the consuming public. Any suggestion that the industry needs only the removal of the remaining wartime controls to achieve economic soundness should be carefully examined in the light of its past history. It is noteworthy that as recently as last year, when a development program for the Acadia Coal Company Ltd. (a subsidiary of Dominion Steel and Coal Corporation Limited) involving an amount of only around $1,000,000 was put forward, the Company sought (and received) government financial guarantees before they would proceed with the work. For the expenditure of the several millions of dollars which is required if physical rehabilitation of the mines is to take place on a wider scale, there is reason to doubt that the situation would be different.

As noted above, I believe that sudden withdrawal of the subsidies started during the war period, and failure to undertake basic physical re-organization measures, will mean inevitable collapse of this industry. I therefore recommend that the Dominion Government should be prepared to continue a degree of subsidy assistance to the coal mining industry of Nova Scotia after the expiration of the emergency wartime powers under which such subsidies are now administered. However, I feel that the Federal Government has a direct claim upon the industry to take all necessary steps for re-organization on a more efficient operating basis, to reduce to a minimum its drain upon the Federal Treasury and to restore it as quickly as possible to its own feet. The existence of such a claim does not rest upon continuation of Federal financial aid; it exists now by virtue of past public assistance and in the interests of the national economy.

Strong recommendations were made, particularly by the trade union organizations of the Maritime Provinces, that the coal industry should be nationalized.

Because of Government subsidies various Nova Scotia coal mining operations have been enabled to continue with inefficient technical methods and with labour policies which have brought about what can only be described as industrial warfare. In spite of this analysis of the situation, I cannot agree that nationalization is a desirable solution. In itself it would not solve the problems which now face coal mining in Nova Scotia. I believe that the situation should be considered as a challenge to private enterprise, and that Government assistance should be continued subject to the private interests making a genuine effort to re-organize this operation. If such an effort were genuinely made, I am convinced that productivity of labour could be greatly increased and substantial progress made in combating the technical difficulties which have raised production costs to such a high level. If this were done marketing problems would be substantially relieved.

It is no part of my Commission to speak regarding the other activities of the Dominion Steel and Coal Corporation, but with respect to coal mining I consider it essential that:

1. The coal operations should be conducted on a commercial basis and coal mining should not be called upon to subsidize other operations of the Dominion Steel and Coal Corporation or be subsidized by them through arbitrary establishment of prices paid for coal at uneconomic levels.
2. Antiquated and inefficient production and handling methods must be re-organized to achieve lower costs. This is essential, and quite possible by application of techniques which are already well recognized and tested by other coal operators. Engineering studies of the coal

> operations of the Dominion Steel and Coal Corporation have revealed the inadequacy of present facilities even at points where the difficulties of undersea mining conditions so frequently mentioned by the Corporation have no relevance, such as for example in cleaning, sizing and bankhead facilities.

In view of the intensity of feeling of Nova Scotia coal mining labour against the present management of the Dominion Steel and Coal Corporation, I cannot pass without direct mention of the admittedly difficult problem stressed in evidence before the Commission of obtaining the co-operation of labour in any plans for re-establishment of the industry on a sound economic basis. Before this Commission, it was flatly stated by representatives of the men that they so distrusted the present management that they could see no hope for a reconciliation and real co-operation between men and management in improving the efficiency of production. I believe that the demand for nationalization of the coal mines of Nova Scotia is primarily a demand to get rid of the present management. The organization of Dosco has been such that there has been every reason for the men to become confused, failing to see clearly the position of the industry and to believe that it was in reality making large profits.

Additional steps are necessary to end the industrial warfare which has now been going on in the Nova Scotia coalfields for generations. Reference of questions affecting the men to Montreal should be reduced to the absolute minimum. The personnel policies of the coal operators should be clearly formulated, fully publicized, and adhered to. They should be administered by officers, trained in personnel work, with authority second only to that of the general managers of the operations and should be enforced upon officials as well as upon the men. The men on their side must give the management, when so re-organized, their full co-operation in increasing productivity by mechanization or modernization, in avoiding casual or frivolous work stoppages in breach of contract, and in negotiating for new contracts promptly and in the true spirit of collective bargaining. Unless these readjustments can be made by both sides, the collapse of the industry appears to be inevitable.

If these readjustments are made, however, there is every reason to be hopeful for the future of coal mining in Nova Scotia. The great need is for increased productivity per man-day. The already low pre-war productivity of 2.54 tons per man-day had fallen to 1.5 tons by 1945. With management committed to introducing and carrying out mining techniques already proved in other fields, and with employees committed to co-operate, there is every reason why pre-war productivity can be not only restored but exceeded, and this great section of the Canadian coal industry rehabilitated.

Nationalization would not necessarily improve the position of the mines or prevent ultimate collapse of the industry. An unsound industry cannot survive indefinitely, and nationalization provides no magic lamp. The facts of wages and working conditions are what count, and if they can be placed on a satisfactory basis under private ownership, the ends of the men will have been met, and I believe that the men will so recognize, even though the unfortunate experiences of the past have led them to think otherwise at the moment.

From the operators' view point, I believe as mentioned previously that the situation should be regarded as a challenge to private enterprise, and the contemplated re-organization considered, not a drastic step forced upon the management, but as a less drastic step than that which will inevitably result if they fail to end the industrial warfare and increasing costs which have been developing in seriousness for so many years.

Mining Machinery

With a view to reducing coal mining production costs I would urge a review of customs duties on production equipment and essential supplies of this industry.

The principle that production equipment and essential supplies required for basic industries should be accorded free entry into Canada, or given a drawback of customs duties when used for such purposes, has been given widespread recognition in the Canadian customs tariff. Unfortunately this principle does not seem to have been applied to coal mining as generally as in the case of some other industries. While certain types of equipment enter Canada duty free, in other cases customs duties are high. A few examples of customs duties on equipment and supplies for coal mining—including as will be noted types of equipment which are "of a class or kind not made in Canada"—are as follows:

Tariff Item	—	British Preferential Tariff	Intermediate Tariff	General Tariff
410a	Face loading machines, shaker trough or belt trough conveyors, air engines, flame proof enclosed driving motors, of a class or kind not made in Canada, and integral parts of all motive power or machinery mentioned in this item, for use exclusively at the face in mining operations..........	Free	10 p.c.	12½ p.c.
410b	Machinery and apparatus for use exclusively in washing or dry cleaning coal at coal mines or coke plants; machinery and apparatus for use exclusively in producing coke and gas; machinery and apparatus for use exclusively in the distillation or recovery of products from coal tar or gas; and complete parts of all the foregoing, not to include motive power, tanks for gas, nor pipes and valves 10½ inches or less in diameter..........	Free	10 p.c.	12½ p.c.
410 l	Ore crushers, rock crushers, stamp mills, grinding mills, rock drills, percussion coal cutters, coal augers, rotary coal drills, n.o.p., and complete parts of all the foregoing, for use exclusively in mining, metallurgical or quarrying operations..........	5 p.c.	20 p.c.	25 p.c.
	—Under U.S.A. Trade Agreement..........	....	17½ p.c.	
410n	Diamond drills and core drills, not including motive power, electrically operated rotary coal drills, and coal cutting machines, n.o.p., and integral parts of the foregoing, for use exclusively in mining operations......	Free	10 p.c.	10 p.c.
ex 410o	Chock release apparatus, for use in coal mines to facilitate the safe removal of chocks forming the roof support....	Free	10 p.c.	10 p.c.
410r	Power driven reciprocating pumps and complete parts thereof, designed for normal working heads of 400 feet and over, for use exclusively underground in mines.....	15 p.c.	25 p.c.	27½ p.c.
410y	Heavy duty mine hoists, of a size and capacity not made in Canada..........	Free	5 p.c.	10 p.c.

There is a point of importance arising from the preferential treatment accorded imports from countries entitled to the British Preferential Tariff. This has been of particular interest to the mines of western Canada, where United States mining methods are more generally practised, but as mechanization progresses eastern Canada may be likewise affected. There are many technical differences between United Kingdom and United States methods of production. Mining machinery from the United Kingdom, designed for use in the longwall mining conducted in that country, is generally unsuitable for use in room and pillar mining prevalent in the West. For such mining methods the only machinery available is manufactured in the United States. Where technical factors make necessary the use of equipment from the United States the higher rates applicable to imports from that country cannot confer any benefit upon suppliers in the United Kingdom. They merely increase production costs, or prevent mechanization.

Apart from rates of duty, difficulties are also presented by administrative rulings of the Department of National Revenue, which have classified various items of equipment which are integral parts of mining machinery under tariff items which carry even higher rates of duty than those applying to mining machinery.

Many of the items upon which high rates of duty are levied are not manufactured in Canada, and moreover it appears unlikely that they will be in view of the relatively small demand in this country for such equipment.

I recommend that these tariff matters be referred for study to the Government Departments concerned with customs duties, and an effort be made to bring the cost of mining machinery to Canadian mines more closely in line with the costs of such machinery to competitive mines in the United States.

Imports

The preceding review of problems has mentioned only the production of Canadian coal. Also basic to Canada's coal problem is the question of the extent to which Canada should attempt to become self-sufficient as regards coal requirements. The central Provinces have always drawn upon United States fields: these imports, although an almost insignificant proportion of United States production, have been sufficiently great in relation to Canadian demand that over the years imports have regularly supplied slightly more than half of the consumption of coal in Canada and about 70 per cent of consumption of the central Provinces. The relationship of Canadian production to imports has been remarkably constant for the past forty years, the only two periods of sharp divergence from the general pattern having been in the two periods of war when the demands of industry in central Canada increased sharply, and drew primarily upon United States coal.

It would be a policy of doubtful wisdom to maintain sufficient mine capacity in Canada to meet the peak demands of war and other possible emergency, leaving a large proportion of this capacity idle in peacetime. Such idle capacity would have a depressing effect upon the coal mining industry as a whole. This would be the case even if, by very costly subvention or subsidy policies, the entire normal demands of the central Provinces were directed to Canadian sources of supply. While seeking to extend the use of coal in the central Canada market, under these circumstances we must recognize that there is an area in central Canada which must continue to be supplied in part from United States sources.

Canadian Coal Board

A Dominion Government agency is needed to co-ordinate the administration of Government activities relating to coal now handled by different Departments, to undertake new research work with respect to both technical and marketing problems, and to distribute information thereon. The need for such an organization was emphasized in submissions presented to this Commission by both operators and men, in both eastern and western Canada.

Under this new agency should be centralized all forms of financial assistance rendered by the Dominion Government to the coal mining industry of Canada, so that a clear picture can be obtained of the relationship of Government to the industry, and adequate steps be taken both to assist the industry and to protect the public interest.

The functions of this new agency should include:

(1) Administration of transportation subventions.

(2) Administration of direct subsidies extended by the Dominion Government to promote production, distribution, and use of coal for specific purposes such as bunkerage and coke production.

(3) Research into marketing problems and techniques.

(4) Technical research on coal mining methods, the physical and chemical characteristics of coal, development of new uses for Canadian coal.

(5) Co-ordination of the activities of other Government Departments such as the Bureau of Mines, the Dominion Bureau of Statistics, and such other Departments as deal with matters relating to coal.

(6) Publication and distribution of information on coal.

(7) Provision of a central point through which representations can be made to the Government on problems respecting coal production, distribution and use.

(8) Advice to the Government on policy respecting coal production, distribution and use.

The status of a Government agency to undertake work of the type just outlined is a matter of importance. The present Dominion Fuel Board as previously noted was originally conceived along fairly broad lines, but in latter years has been almost entirely a supervising body for distributing one form of financial assistance, namely transportation subventions. This Board consisted of civil servants, and the extent of the Board's responsibilities and authority was set out only by Order in Council. It had no statutory authority. I consider that the proposed agency could be given the title "The Canadian Coal Board" and should be organized along entirely different lines. It should be established by statute which will clearly set forth its authorities and responsibilities, and give it a more assured and permanent status than is accorded to organizations established by Order in Council only. It should be made responsible directly to a Cabinet Minister, so that a member of the Government will have a direct responsibility for ensuring that it is operating in accordance with Government policy, and can report to Parliament on its operations. In contrast to the present Dominion Fuel Board, there should be a full time Chairman, who could be held responsible for its efficient administration. A part of the dissatisfaction with the way in which the present Dominion Fuel Board has operated in its restricted field is attributable to the fact that even prior to the war it had ceased to function as a Board because of removals and deaths, and its work seemed to be centred upon a Secretary who could act according to his discretion only within certain regulations.

A large part of the work of the proposed Canadian Coal Board would deal with the expenditure of public funds, and policy relating to such expenditures must of course be a responsibility of the Government. The Board would be an administrative and an advisory body, rather than a policy-making body. It would therefore be appropriate to include upon it representatives of the coal mining industry, employers and employees, as well as of the Dominion Government.

Under the present constitutional division of authority between the Dominion Government and the Provinces, exclusive legislative authority of the Provinces extends to "the management and sale of the public lands belonging to the Provinces", "property and civil rights in the Provinces" and "matters of a merely local or private nature in the Province". Generally speaking this has been interpreted to include jurisdiction over such things as the manner in which coal mines are to be operated, safety measures to be observed, matters concerning wages, hours of work, labour welfare and the settlement of disputes, and marketing practice in so far as sales within a province are concerned. It also includes in the case of provincial lands, authority over the granting of coal leases, and the royalties and rentals to be paid thereunder. Direct taxation of coal mining operations is also, of course, a privilege of the provinces, which can thereby directly influence the course of development of the industry. It can readily be seen that any long-range plan for the coal industry by the Dominion Govern-

ment cannot fail to take into account policies of the governments of the several coal-producing provinces. Likewise, Dominion Government policies concerning coal production are of great importance to the provinces concerned, from the aspects of both maintenance of employment and the financial prosperity of the operators. I therefore feel that it would be highly desirable to enlist the full co-operation of the provincial governments in the development and administration of Federal measures respecting coal, and machinery now exists through which co-operation could be developed.

The financial reserves to be placed at the disposal of the Canadian Coal Board must be provided by authority of Parliament. Estimates should be adequate to carry out steadily the long-term policies that may be determined upon by the Government, rather than having policy arbitrarily varied during the course of a year by reason of inadequacy of estimates. Particular reference to this is made in my following comments on the unsatisfactory situation with respect to administration of transportation subventions in past years.

As already noted, the expenditures of public funds through transportation subventions, and for a while at any rate through the continuation of direct subsidies, will be particularly important functions of the Canadian Coal Board. Separate notes follow on these two items.

Transportation Subventions

A complete re-casting of the administration of transportation subventions is necessary, to achieve effective results with a minimum expenditure of public funds. Administration of transportation subventions since their inception some twenty years ago has been somewhat unsatisfactory. To understand the principles upon which I consider it essential that payment of such subventions be based in future, it is necessary to refer briefly to the regulations and methods of administration which have applied to date.

Following a brief experimental movement of coal through the assistance of public expenditures, a general policy of transportation subventions was developed at the end of the 1920's. The general purpose of these subventions has been to enable Canadian coal to compete in areas in Canada where it would otherwise not be competitive. A logical overall basis on which subvention payments might have been determined would have been to set geographical limits within which Canadian coal would be made competitive, and provide subvention payments to the extent necessary to move Canadian coal within these limits, with some assurance of consistency in policy from year to year. This would have given suppliers who developed new markets with the aid of subventions assurance that such aid would be available over a period of years; in turn customers would have been given a feeling of security that Canadian coal would continue to be made competitive in their local markets. Unfortunately, no such basis was used. Subvention assistance has varied greatly from year to year. There has never been any guarantee that markets developed by the aid of subventions would be given subvention assistance in a subsequent year if required to make prices competitive. This has prevented long-term development of new markets with any assurance to consumers or operators of continuity of supply on a competitive basis.

Even within the areas and time limits for which subventions might be approved in a given year, it has frequently been found that movements of coal which otherwise qualified were denied subvention assistance merely by the accident that subvention claims filed previously by operators in other parts of the country had exhausted the funds voted for subventions.

Subvention policies and freight rates are necessarily interwoven, and both will materially affect the competitive position of Canadian and imported coals in the areas to which we have already referred.

To enable transportation subventions to achieve the ends for which they were devised, it is necessary that certain principles must govern their provision and administration. These are that:

(1) Policy be clearly defined and set, rather than left to individual negotiation.

(2) Consistency of policy be developed, to give some assurance that markets developed in one year will not be left outside the competitive areas of the Canadian producers in a subsequent year.

(3) Adequate advance commitments be available, to enable producers to plan their sales and develop new customers.

(4) Adequate finances be provided.

Other Financial Assistance

Mention must also be made of other forms of financial assistance. These have in most instances been a wartime development, but in some cases had already been in effect for varying periods of years before the war.

It is not easy even to compile a complete list of the forms of subsidy assistance which have been extended to the coal mining industry. Among those in effect prior to the war were a direct subsidy extended to producers in British Columbia, and to distributors of British Columbia coal sold for bunkerage or for export to foreign countries other than the United States. The British Columbia export and bunkerage assistance involved payments by the Dominion Government in excess of a million and a quarter dollars since 1931 to Canadian Collieries (Dunsmuir) Limited, the only producer benefiting. Under the Domestic Fuel Act, 1927, the building of coke plants to use Canadian coal was subsidized. Subsequently by Orders in Council further assistance was given to stimulate the use of Canadian coal for coking, by providing subsidies to make Canadian coal competitive with imported coals. The Coke Bounties Act, 1930, granted a bonus to persons using coke made from Canadian coal for the manufacture of certain primary iron and steel products. Other peacetime assistance from the Dominion Government might also be mentioned, such as the Maritime Freight Rates Act by which all rail movements of coal (among other products) originating within the Maritime Provinces are directly subsidized by the Federal Government to the extent of 20 per cent of the railways' receipts for freight services.

The Customs Tariff on imported coal and coke is another form of Government assistance to the coal industry.

The foregoing examples are sufficient to illustrate the Dominion Government's assistance to the coal mining industries of Canada. My emphasis on the extent of this assistance is not intended as a criticism of these measures, or a suggestion that they have not been for the good of both the industry and the Canadian economy as a whole. It is directed to making the point that the Dominion Government has a claim upon the recipients of such benefits to conform to requirements of the Dominion Government for the efficient organization of the industry in the national interest; an industry in this position cannot claim that its affairs are purely its own private concern. He who pays the piper still should call the tune.

The foregoing references were to subsidies and other assistance which were extended by the Dominion Government prior to the war. In addition to these, many forms of special financial assistance were extended by the Dominion Government during the war period, through such agencies as the Emergency Coal Production Board and the Commodity Prices Stabilization Corporation. To the extent that such wartime subsidies have now been withdrawn or are in

process of withdrawal I have no comment to offer; they were emergency measures dealing with a situation which is now past, and the interests of this Commission lie with the future.

With respect to certain of these subsidies paid in Nova Scotia, it has already been noted that it appears impossible that assistance can be completely terminated in the immediate future. At the present time the productivity of the Maritime mines is so low, and the cost of producing coal therefore so high, that without some action to reduce costs the market for those coals will be seriously restricted. Until the physical re-organization of the mines to achieve lower production costs can be completed, there may be a need for additional assistance beyond those types extended prior to the war. Such assistance should be given only as a transitional measure, to give the operators an opportunity to undertake the long overdue technical re-organization needed to lower their costs of production.

It is necessary for the efficient administration of such assistance as may be required, to establish machinery to carry on when the wartime control agencies have gone out of existence. I recommended previously that this should be one of the functions of the Canadian Coal Board. The Board should advise the Government upon the steps necessary to ensure that the industry undertake the re-organization of its operations necessary to minimize the amount of such public assistance and eliminate the temporary assistance entirely as soon as possible, and the continuation of Dominion financial assistance in any form should be clearly related to the operators undertaking specified re-organization programs submitted in advance and approved by the Canadian Coal Board.

Failing full co-operation by the operators with the Government by reorganization of their operations, in return for the public aid they have already received and continuation of special financial assistance, the Government would be forced to consider its further course of action.

The coal lands in Nova Scotia are Crown lands in right of the Province, with the operators holding only leases. The proprietary interest of the Province of Nova Scotia in its coal leases is such that any necessary action could better be taken by the Province than by the Federal Government. The fact that the companies concerned hold provincial rather than Dominion charters provides another avenue of approach through provincial channels to any necessary enforcement action. I would hope that the coal operators would recognize that the rehabilitation which I regard as an essential prerequisite for the financial assistance of the Dominion Government is in their own interests. If such recognition should not be forthcoming the attention of the Nova Scotia Government should be drawn to the impossibility of the continuation of Dominion Government financial assistance and the consequences of failure to place the industry upon a sounder basis, and the support of that Government enlisted in bringing about the necessary re-organization.

Accounting Records

There is great lack of uniformity in the accounting procedures of the coal companies. Some companies maintain elaborate cost records, others have practically no cost accounting system. There is also a wide variation in practice regarding classification of costs, and perhaps of most importance as between operating and capital accounts.

Because of this lack of uniformity, determination of the need for government assistance, through transportation subventions and in other forms, has been rendered particularly difficult. To ensure consistency of treatment as between operators, and to protect adequately the Government's interest in the administration of public funds, I recommend that standardized accounting procedures be prepared, and that all companies receiving government assistance in the distribution or production of coal be required to adhere to such accounting procedures.

I have already recommended that all forms of financial assistance rendered by the Dominion Government to the coal mining industry be centralized under a Canadian Coal Board. Preparation of standard accounting procedures for the mines should be undertaken by this Board.

Working and Social Conditions of the Miners

I have dealt at some length with problems of production and distribution of coal in Canada. To the extent that the suggestions which I have made, and others which might be developed, can be placed in effect and the general prosperity of the industry improved, the mine workers will be assisted in their efforts to achieve higher and more stable earnings. There are however some points concerning working and social conditions in the mine communities which require special mention. Present housing and community facilities in many localities reflect no credit on the industry. Government and employers should recognize that, if men are to remain in or come into the industry, the welfare of the employees must receive much more attention than it has to date.

One abuse to which I must draw particular attention is the "closed camp" which still exists in some parts of western Canada. In such camps the local coal operator controls all land within convenient distance of the mines, owns all housing and controls all stores, hotels and service facilities. Water supply, sanitation and other public utilities are arranged by the coal operator, and are frequently quite inadequate. The people living in these camps should be free to buy or to lease for long terms, land on which to build their own homes; decent standards of sanitation should be enforced; and any person who so desires should be free to conduct a business in such camps under no greater restrictions than those in effect in "open towns". The provincial governments, under whose jurisdiction such matters rest, should take immediate action to this end.

I strongly recommend the creation of industry-wide retirement pension plans for mine workers. The miners in the past have lived in economic insecurity as a result of the wide fluctuations in activity which the industry has experienced. Federal unemployment insurance now reduces this insecurity to some extent but there remains the ever-present spectre of poverty in old age. I therefore stress the desirability of pension plans, to be financed jointly by operators, men and government. Provincial government contributions to such funds could be made from the royalties the provincial governments now collect on coal mined.

Summary

(1) Because of the widely varying problems of the several sections of the coal mining industry of Canada, it is necessary to develop not one, but several series of recommendations.

(2) The Dominion Government already has a large financial "investment" in the Canadian coal mining industry, through financial assistance which has been extended in a variety of ways.

(3) A Canadian Coal Board should be established, to advise the Government on assistance to the industry and protection of the public interest, and to administer such assistance as the Government deems necessary.

(4) The system of transportation subventions should be reorganized and extended.

(5) Local adjustments should be made, along lines which I have indicated in this report, to assist in marketing coal from specific areas and to minimize such factors as seasonal fluctuations in activity.

(6) The customs duties applying to mining machinery and supplies should be reviewed, and so far as possible reduced.

(7) The Dominion Government should be prepared to continue for a limited period a degree of special financial assistance to the coal mining industry of Nova Scotia, if the operators are prepared to rehabilitate their operations.

(8) All companies receiving government assistance in the distribution or production of coal should be required to adhere to standardized accounting procedures.

(9) The provincial governments should take immediate action to eliminate "closed camps".

(10) Retirement pension plans for coal mine workers should be instituted.

Respectfully submitted,

A. J. MORRISON,
Commissioner.

OTTAWA,
December 14, 1946.

APPENDIX A

PRELIMINARY ESTIMATE OF CANADIAN COAL RESERVES BY PROVINCES, AREAS AND RANK AS PREPARED BY DR. B. R. MACKAY FOR THE ROYAL COMMISSION ON COAL, SEPTEMBER, 1946

PRELIMINARY ESTIMATE OF CANADIAN COAL RESERVES BY PROVINCES, AREAS AND RANK AS PREPARED BY DR. B. R. MACKAY FOR THE ROYAL COMMISSION ON COAL, SEPTEMBER, 1946

TABLE 1.—RESERVES BY PROVINCES

(Thousands of net tons)

Province	Mineable			Recoverable		
	Probable	Possible (Additional)	Total	Probable	Possible (Additional)	Total
Nova Scotia	1,967,024	1,147,382	3,114,406	983,512	573,691	1,557,203
New Brunswick	89,814	11,566	101,380	44,907	5,783	50,690
Ontario	100,000	50,000	150,000	50,000	25,000	75,000
Manitoba	33,600	67,200	100,800	16,800	33,600	50,400
Saskatchewan	13,126,880	11,004,000	24,130,880	6,563,440	5,502,000	12,065,440
Alberta	34,437,740	13,436,560	47,874,300	17,218,870	6,718,280	23,937,150
British Columbia	11,795,480	7,034,556	18,830,036	5,897,740	3,517,278	9,415,018
Yukon	434,560	1,449,840	1,884,400	217,280	724,920	942,200
Northwest Territories	140,000	2,489,760	2,629,760	70,000	1,244,880	1,314,880
CANADA TOTAL	62,125,098	36,690,864	98,815,962	31,062,549	18,345,432	49,407,981

TABLE 2.—RESERVES BY RANK AND BY PROVINCES

PART I.—PROBABLE COAL

(Thousands of net tons)

Province	Low Vol tile Bituminous		Medium Volatile Bituminous		High Volatile Bituminous		Sub-bituminous		Lignite		Total	
	Mineable	Recoverable	Mineable	Recoverable	Mineable	Recoverable	Mineable	Recoverable	Mineable	Recoverable	Mineable	Recoverable
Nova Scotia	2,360	1,180	25,504	12,752	1,939,160	969,580					1,967,024	983,512
New Brunswick					89,814	44,907					89,814	44,907
Ontario									100,000	50,000	100,000	50,000
Manitoba									33,600	16,800	33,600	16,800
Saskatchewan									13,126,880	6,563,440	13,126,880	6,563,440
Alberta	8,797,600	4,398,800	11,854,080	5,927,040	7,540,940	3,770,470	6,245,120	3,122,560			34,437,740	17,218,870
British Columbia	966,000	483,000	10,337,748	5,168,874	278,932	139,466			212,800	106,400	11,795,480	5,897,740
Yukon			87,360	43,680	24,640	12,320			322,560	161,280	434,560	217,280
Northwest Territories					30,240	15,120			109,760	54,880	140,000	70,000
Total	9,765,960	4,882,980	22,304,692	11,152,346	9,903,726	4,951,863	6,245,120	3,122,560	13,905,600	6,952,800	62,125,098	31,062,549

PART II.—POSSIBLE COAL

(Thousands of net tons)

Province	Low Volatile Bituminous		Medium Volatile Bituminous		High Volatile Bituminous		Sub-bituminous		Lignite		Total	
	Mineable	Recoverable	Mineable	Recoverable	Mineable	Recoverable	Mineable	Recoverable	Mineable	Recoverable	Mineable	Recoverable
Nova Scotia	6,720	3,360	16,000	8,000	1,124,662	562,331					1,147,382	573,691
New Brunswick					11,566	5,783					11,566	5,783
Ontario									50,000	25,000	50,000	25,000
Manitoba									67,200	33,600	67,200	33,600
Saskatchewan									11,004,000	5,502,000	11,004,000	5,502,000
Alberta	4,334,400	2,167,200	3,315,200	1,657,600	3,473,120	1,736,560	2,310,480	1,155,240	3,360	1,680	13,436,560	6,718,280
British Columbia	1,066,800	533,400	4,551,680	2,275,840	630,956	315,478			785,120	392,560	7,034,556	3,517,278
Yukon			182,560	91,280	28,560	14,280			1,238,720	619,360	1,449,840	724,920
Northwest Territories					1,696,800	848,400			792,960	396,480	2,489,760	1,244,880
Total	5,407,920	2,703,960	8,065,440	4,032,720	6,965,664	3,482,832	2,310,480	1,155,240	13,941,360	6,970,680	36,690.864	18,345,432
GRAND TOTAL	15,173,880	7,586,940	30,370,132	15,185.066	16,869,390	8,434,695	8,555,600	4,277,800	27,846,960	13,923,480	98,815,962	49,407,981

TABLE 3.—SUMMARY OF RESERVES OF NOVA SCOTIA BASED ON COAL SEAMS NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 4,000 FEET*

(Thousands of net tons)

District	Mineable		Recoverable	
	Probable	Possible (Additional)	Probable	Possible (Additional)
Sydney Coalfield	1,764,184	915,152	882,092	457,576
West Coast of Cape Breton Island	44,982	35,320	22,491	17,660
Richmond-Loch Lomond	10,080	10,080	5,040	5,040
Pictou County	63,994	50,230	31,997	25,115
Cumberland County	81,424	129,880	40,712	64,940
Colchester County**	2,360	6,720	1,180	3,360
Nova Scotia Total	1,967,024	1,147,382	983,512	573,691

* Estimate of Joggins coal field in Cumberland County includes some seams of minimum thickness of 2 feet.

** Coal classifies as Class II, Group 1 (low volatile bituminous) under A.S.T.M. standards.

TABLE 4.—RESERVES OF SYDNEY COALFIELD, CAPE BRETON ISLAND, NOVA SCO
OF 4,000 FEET, OR NOT MORE
(Thousands

Name of Seam and Correlation	District	Strata Thickness (feet) and Range	Coal Seam Thickness (feet)		Mine		
					Probable		
			Range	Av.	Thick-ness used (feet)	Area (sq. miles)	Tonnage
Point Aconi—Upper Seam	(4) Sydney Mines....		3–3.8	3.5	....	....	....
		11–16					
Point Aconi—Lower Seam							
Lloyd Cove or	(3) New Waterford ..	200–250	....	....	3.0	4.2	14,112
Bonar Seam	(4) Sydney Mines....		4–9.0	5.0	3.0	35.0	117,600
Hub Seam or	(2) Glace Bay.......	180–230	0–11.7	4.5	4.5	34.2	172,368
Barachois or	(3) New Waterford ..		....	5.5	4.5	26.0	131,040
Chapel Point	(4) Sydney Mines....		0–10.8	6.0	6.0	24.5	164,640
Blockhouse or	(1) Morien...........	285–380	0–9.2	9.0	4.5	3.0	15,120
Harbour or	(2) Glace Bay.......		0–9.2	6.0	6.0	45.5	305,760
Victoria or	(3) New Waterford ..		0–7.5	5.0	5.0	22.2	124,320
Sydney Main	(4) Sydney Mines....		0–9.3	5.0	5.0	20.0	112,000
Bouthillier or Edwards or	(2) Glace Bay........	240–350	2–4.0	3.0	3.0	8.6	28,896
Millpond	(4) Sydney Mines....		0–4.5	3.0	3.0	1.6	5,376
Trunnelshed or	(1) Morien...........	70–120	....	3.0	3.0	2.4	8,064
Backpit or	(2) Glace Bay.......		....	....	3.0	8.6	28,896
North Head or	(3) New Waterford ..		....	....	3.0	3.5	11,760
Indian Cove	(4) Sydney Mines....		1–7.0	3.0	3.0	5.5	18,480
Gowrie or	(1) Morien...........	80–130	5–8.0	6.0	5.5	4.5	27,720
Phalen or	(2) Glace Bay.......		6–9.0	7.0	6.5	23.5	171,080
Lingan or Blackrock or	(3) New Waterford ..		3–7.0	6.0	5.5	20.5	126,280
Collins or	(4) Sydney Mines....		....	5.0	5.0	1.5	8,400
Four Foot Seam	(5) New Campbellton		....	....	3.0	1.1	3,488
Six Foot or Stony	(5) New Campbellton	90–100	0–6.0	3.0	3.0	0.9	3,024
Emery or	(1) Morien...........	20–40	2–6.0	4.0	4.0	3.0	13,440
Spencer	(2) Glace Bay.......		1–6.6	4.0	4.0	8.3	37,184
Gardiner or	(2) Glace Bay.......	365–425	0–6.0	4.0	4.0	7.3	32,704
Long Beach	(1) Morien...........		0–6.0	....	....	....	....
Mullins	(3) New Waterford ..	510–555	0–6.0	4.0	4.0	10.0	44,800
Tracy	(1) Morien...........	1000	0–5.0	4.0	4.0	8.4	37,632
GRAND TOTAL...							1,764,184

TIA, BASED ON SEAMS NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH
THAN 5 MILES FROM SHORE
of net tons)

able			Recoverable		A.S.T.M. Classification	Remarks
Possible (Additional)						
Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)		
3	40.0	134,400	....	67,200	II 3	Lower seam averages less than 1 foot. Reserve classified as possible as no development and quality unknown. Seam may extend over same area as Hub seam. This would add a further 33 sq. miles or 110,000,000 tons mineable coal. Open cut operations possible at Point Aconi.
3	14.0	47,040	7,056	23,520		Seam probably persists over greater area and in greater thickness than assumed in estimate as indicated on map.
3	29.0	97,440	58,800	48,720		
....	....	....	86,184	....		Believed to be one of the most important seams in the field. Under Sydney Harbour it splits, which condition persists west to Chapel Point and to at least 3 miles northeast of Cranberry Head as indicated by borings from Princess Colliery.
3	8.5	28,560	65,520	14,280		
3	28.5	95,760	82,320	47,880		
....	....	....	7,560	....		One of the most important and extensively mined seams, consistent in thickness and quality over wide area. Western boundary of reserve determined by Florence Colliery workings.
....	....	....	152,880	....		
....	....	....	62,160	....		
....	....	....	56,000	....		
3	22.5	75,600	14,448	37,800		Seam seldom 4-foot thick. Limited areas only included in estimate due to general thinness of seam and lack of information of behaviour of seam in submarine areas.
3	13.0	43,680	2,688	21,840		
....	....	....	4,032	....		Seam persists throughout the field, but thin in western area. Highly possible can be mined submarine, but land areas only included as *probable* reserves. Submarine extension taken as 3 miles from outcrop with variations according to special factors.
3	6.2	20,832	14,448	10,416		
3	13.5	45,360	5,880	22,680		
3	14.5	48,720	9,240	24,360		
....	....	....	13,860	....		Most important and extensively mined seam in field. Most valuable reserve of easily accessible coking coal occurs in Lingan district. Seam thins west of New Waterford area and is very thin and dirty in Sydney mines area.
3	8.5	28,560	85,540	14,280		
5	6.5	36,400	63,140	18,200		
....	....	....	4,200	....		
....	....	....	1,744	....		
....	....	....	1,512	....		Seam is lower branch of Phalen seam. May not extend east of Sydney Harbour. Apart from New Campbellton area seam is of insufficient thickness to be mineable.
....	....	....	6,720	....		Lowest seam worked in submarine area. Seam thins seaward. Submarine reserves considered small. Good quality coal with low sulphur content and relatively high fusion point of ash.
....	....	....	18,592	....		
3	19.8	66,640	16,352	33,320		Seam in mineable thickness extends over limited area only. New Colliery recently opened. Reserve largely shown as possible reserve as the seam is thin, dirty or splits. No submarine extension is included.
3	12.0	40,320	....	20,160		
3	11.5	38,640	22,400	19,320		Inability to mine this seam in conjunction with seams above limits its potential development; quality of coal is mediocre.
4	15.0	67,200	18,816	33,600		Small operations at Hiawatha and Broughton Mines. Seam thins and deteriorates westward.
....	....	915,152	882,092	457,576		

TABLE 5.—RESERVES OF CAPE BRETON ISLAND, NOVA SCOTIA, OTHER THAN SYDNEY COALFIELD, BASED ON SEAMS NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 4,000 FEET, OR NOT MORE THAN 3 MILES FROM SHORE

(Thousands of net tons)

District and Area	Name of Seam	Coal Seam Thickness (feet)		Mineable						Recoverable		A.S.T.M. Classification
				Probable			Possible (Additional)					
		Range	Av.	Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)	
Port Hood	Six Foot	5–7	6	3.0	6.5	21,840	3	3.5	11,760	10,920	5,880	II 5
Mabou	Seven Foot	5–7	6	5.0	0.1	560	5	0.3	1,680	280	840	II 5
	Eight Foot	6–8	7	6.0	0.1	672	6	0.3	2,016	336	1,008	
	Fifteen Foot	....	10	10.0	0.3	3,360	10	0.5	5,600	1,680	2,800	
	Five Foot	....	5	5.0	0.4	2,240	5	0.41	2,280	1,120	1,140	
Inverness	Thirteen Foot	0–13	5	4.5	0.1	500	....	....	....	250		II 5
	Seven Foot	....	....	3.0	0.03	100	....	....	....	50		
	Forty-two Inch	....	....	3.0	0.15	500	....	....	....	250		
	Port Ban	0–7	5	5.0	0.62	3,460	3	1.0	3,360	1,730	1,680	
St. Rose-Chimney Corner—												
St. Rose	No. 2	3–8	6	4.0	0.5	2,130	4	0.3	1,344	1,065	672	II 5
	No. 5	6–8	7	7.0	0.8	6,704	7	0.5	3,920	3,352	1,960	
Chimney Corner	No. 1											
	No. 2	....	4	3.0	0.4	1,304	3	0.5	1,680	652	840	
	No. 4											
	No. 5	6–8	7	3.0	0.48	1,612	3	0.5	1,680	806	840	
Total	....	....	....	....	....	44,982	....	....	35,320	22,491	17,660	
Richmond	Whiteside	3–11	5	3.0	1.0	3,360	3	1.0	3,360	1,680	1,680	II 3
	Seal Coal Bay	....	....	3.0	1.0	3,360	3	1.0	3,360	1,680	1,680	
Loch Lomond	Salmon River	0–4	3	3.0	1.0	3,360	3	1.0	3,360	1,680	1,680	II 3
Total	....	....	....	....	....	10,080	....	....	10,080	5,040	5,040	
GRAND TOTAL	....	....	....	....	....	55,062	....	....	45,400	27,531	22,700	

TABLE 6.—RESERVES OF PICTOU COALFIELD, PICTOU COUNTY, NOVA SCOTIA, BASED ON SEAMS NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 4,000 FEET

(Thousands of net tons)

Area	Name of Seam	Strata Thickness (feet) and Range	Coal Seam Thickness (feet)		Mineable						Recoverable		A.S.T.M. Classification
					Probable			Possible (Additional)					
			Range	Av.	Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)	
Thorburn.........	Captain.........	50	....	3.0	3.0	0.08	264	....	....	....	132	....	II 3
	Millrace.........	56	....	2.75									
	McKay..........	521	....	3.5	3.5	0.43	1,680	3	0.25	840	840	420	
	Six Foot.........	600	....	6.0	6.0	0.14	940	3	0.5	1,680	470	840	
	McBean..........		3-8	5.0	6.5	1.4	10,000	3	0.5	1,680	5,000	840	
Total.........	....	....	....	....	....	....	12,884	....	....	4,200	6,442	2,100	
Stellarton........	Foord..........	200–100	2–35.0	30.0	12.0	0.85	10,000	2–10	2.0	11,200	5,000	5,600	II 3
	Cage............	150–85	12–20.0	15.0	14.0	0.04	600	3–15	6.0	2,000	300	1,000	
	Third...........	190–90	14.0	12.0	7.5	0.18	1,512	3–4	3.1	1,150	756	575	
	McGregor or Fleming	70–60	15.0	15.0	6.0	0.43	2,670	3–15	0.5	5,600	1,335	2,800	
	Acadia No. 1....	167–110	11.0	8.0	8.0	0.4	3,584	5	1.8	10,080	1,792	5,040	
	Norah...........	65–25	7.0	5.0	5.0	0.15	800	....	....	....	400		
	No. 5............	70–60	21.0	5.0	5.0	0.13	640	....	....	....	320		
	No. 6............	75–50	3.0	3.0	....	....	2,000	....	....	....	1,000		
	No. 8............	47	5.0	5.0	....	....	2,000	....	....	....	1,000		
	No. 9............		5.0	5.0	....	....	1,800	....	....	....	900		
Total.........	....	....	....	....	....	....	25,606	....	....	30,030	12,803	15,015	
Westville.........	Acadia or Main..	10–170	16–18.0	17.0	13.1	0.9	13,408	....	....	5,000	6,704	2,500	II 2
	Scott............	100–120	11–12.5	12.0	12.0	0.9	12,096	....	....	6,000	6,048	3,000	
	Third...........	100–130	....	6.0	....	....	....	6	0.3	2,000	....	1,000	
	Fourth..........		....	6.0	....	....	....	6	0.45	3,000	....	1,500	
Total.........	....	....	....	....	....	....	25,504	....	....	16,000	12,752	8,000	
GRAND TOTAL	....	....	....	....	....	....	63,994	....	....	50,230	31,997	25,115	

TABLE 7.—RESERVES OF COALFIELDS OF CUMBERLAND COUNTY, NOVA SCOTIA, BASED ON SEAMS NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 4,000 FEET*

(Thousands of net tons)

District and Area	Name of Seam	Coal Seam Thickness (feet)		Mineable						Recoverable		A.S.T.M. Classification
				Probable			Possible (Additional)					
		Range	Av.	Thickness used (feet)	Area (Sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)	
Springhill	No. 3	7.0–12.0	10.0	8.0	1.0	8,960	3.0	3.0	10,080	4,480	5,040	II 3
	No. 1	6.0–10.0	8.0	8.0	1.5	13,440	3.0	7.0	23,520	6,720	11,760	
	No. 2	7.0–17.0	10.0	9.0	0.5	5,040	3.0	8.5	28,560	2,520	14,280	
	No. 7	4.0– 7.0	5.0	5.0	0.4	2,240	3.0	4.0	13,440	1,120	6,720	
	No. 6	5.0– 7.0	6.0	6.0	0.7	4,704	3.0	4.0	13,440	2,352	6,720	
Total	....	....	....	....	....	34,384	....	....	89,040	17,192	44,520	
Joggins— Joggins	Joggins	4.0–6.0	5.0	5.0	2.0	11,200	3.0	2.0	6,000	5,600	3,000	II 3
	Queen	1.0–3.0	2.5									
	Kimberly	1.0–3.0	2.0									
	Forty Brine	2.5–3.5	2.7									
	Fundy or Hard scrabble	1.0–2.5	2.0									
River Hebert	Joggins (Victoria)	4.0–6.0	5.0	5.0	0.89	5,000	5.0	0.89	5,000	2,500	2,500	II 3
	Queen	1.0–3.0	2.5	2.5	1.1	3,000	2.5	0.71	2,000	1,500	1,000	
	Kimberly	1.0–3.9	3.0	3.0	0.74	2,500	3.0	0.74	2,500	1,250	1,250	
	Forty Brine	0–3.5	2.5	2.5	0.89	2,500	2.5	0.54	1,500	1,250	750	
	Twin or Fundy	0–2.8	2.0	2.0	0.45	1,000	2.0	0.89	2,000	500	1,000	
Maccan	Lawson	0– 8.0	6.0	6.0	1.5	10,080	3.0	3.0	10,080	5,040	5,040	II 3
	Chignecto	0–13.0	5.0	3.0	3.5	11,760	3.0	3.5	11,760	5,880	5,880	
Total	....	....	....	....	....	47,040	....	....	40,840	23,520	20,420	
GRAND TOTAL	....	....	....	....	....	81,424	....	....	129,880	40,712	64,940	II 3

* Estimate of River Hebert and Maccan areas includes coal seams not less than 2 feet in thickness.

TABLE 8.—RESERVES OF NEW BRUNSWICK (MINTO FIELD), BASED ON SEAMS NOT LESS THAN 18 INCHES IN AVERAGE THICKNESS TO A MAXIMUM DEPTH OF 500 FEET

(Thousands of net tons)

District		Coal Seam Thickness (inches)			Area (acres)	Mineable		Recoverable		A.S.T.M. Classification
No.	Name	Range	Average	Used in Estimate		Probable	Possible (Additional)	Probable	Possible (Additional)	
1	Upper 18 Brook	16 – 30	18	18	690	....	1,811	....	906	II 3
2	Lower 18 Brook	....	24	24	608	2,128	....	1,064		
3	Sheffield	....	21	21	446	1,366	....	683		
4	Lower Little River	....	21	21	78	....	239	....	119	
5	Upper Little River	....	18	18	378	992	....	496		
6	North Minto	....	24	24	761	2,664	....	1,332		
7	South Minto	....	21	21	2,411	7,384	....	3,692		
8	Midland	....	18	18	21,040	55,230	....	27,615		
9	Salmon River	....	18	18	73	....	192	....	96	
10	North Forks	....	18	18	400	....	1,050	....	525	
11	Chipman (West)	....	18	18	5,917	15,532	....	7,766		
12	Chipman (East)	....	18	18	3,152	....	8,274	....	4,137	
13	Coal Creek	....	18	18	1,721	4,518	....	2,259		
	Total Minto Field				37,675	89,814	11,566	44,907	5,783	

TABLE 9.—RESERVES OF SASKATCHEWAN, BASED ON SEAMS NOT LESS
(Thousands

District and Area	Name and Number of Seam	Strata Thickness (feet) and Range	Coal Seam Thickness (feet)		Depth (feet)		Area underlain by Coal Formation (sq. miles)	
			Range	Av.	Range	Av.	Total	Area used
SOUTHERN SASKATCHEWAN (Tertiary)							10,000	
SOURIS RIVER VALLEY							4,900	
(1) Estevan Block							432	
	Frayne or No. 1	52	4.0–6.0	5	0–70	35		20
	Roche Percee or No. 2	20	4.0–6.0	5	0–135	65		30
	Estevan	25	0–10.0	7	100–160	130		95
	Taylorton or No. 4	130	9.0–15.0	10				150
	No. 5	207	3.0–4.0	2				
	No. 6	209	3.0–6.0	4				
	No. 7	31	3.0–5.0	4				
	No. 8		3.0–6.0	4				
(2) Lampman Block							970	
	No. 6	207	2.0–10.0	4	150–300	250		250
	No. 7	31	3.0–5.0	4	100–450	200		300
	No. 8		3.0–5.0	4	80–500	200		400
(3) Oxbow Block							1,800	
	No. 6	130	3.0–5.0	4	50–400	300		360
	No. 7	30	0–10.0	4	80–450	350		350
	No. 8		3.0–5.0					350
(4) Weyburn Block							1,500	
	No. 6	200	2.0–8.0	4	50–300	150		250
	No. 7	30	3.0–5.0	4	95–450	300		600
	No. 8		3.0–5.0	4	100–500	350		600
Total								
WOOD MOUNTAIN-WILLOWBUNCH							4,200	
(1) Radville Block							1,500	
	Big Muddy	270	5.0–8.0	7	0–500	45		250
	Keogh		5.0–10.0	7	0–300	100		400
(2) Willowbunch Block							1,800	
	Willowbunch	200	5.0–15.0	7	0–80	45		270
	Harptree	70	5.0–7.0	6	20–100	60		400
	Gye or St. Victor	130	3.5–7.5	5	20–160	90		300
	Anchor		5.0–10.0	6	0–160	90		80

THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 500 FEET
of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)					
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)	
								IV
5	10.0	56,000	3	10	33,600	28,000	16,800	
5	15.0	84,000	3	15	50,400	42,000	25,200	
6	45.0	302,400	3	50	168,000	151,200	84,000	
10	80.0	896,000	3	70	235,200	448,000	117,600	
3	150.0	504,000	3	100	336,000	252,000	168,000	
3	150.0	504,000	3	150	504,000	252,000	252,000	
3	200.0	672,000	3	200	672,000	336,000	336,000	
3	200.0	672,000	3	160	537,600	336,000	268,800	
3	200.0	672,000	3	150	504,000	336,000	252,000	
3	200.0	672,000	3	150	504,000	336,000	252,000	
3	100.0	336,000	3	150	504,000	168,000	252,000	
3	250.0	840,000	3	350	1,176,000	420,000	588,000	
3	250.0	840,000	3	350	1,176,000	420,000	588,000	
....	....	7,050,400	....	....	6,400,800	3,525,200	3,200,400	
6	150.0	1,008,000	3	100	336,000	504,000	168,000	
6	200.0	1,344,000	3	200	672,000	672,000	336,000	
6	150.0	1,008,000	3	120	403,200	504,000	201,600	
5	100.0	560,000	3	300	1,008,000	280,000	504,000	
5	100.0	560,000	3	200	672,000	280,000	336,000	
5	50.0	280,000	3	30	100,800	140,000	50,400	

TABLE 9.—RESERVES OF SASKATCHEWAN, BASED ON SEAMS NOT LESS THAN
(Thousands

District and Area	Name and Number of Seam	Strata Thickness (feet) and Range	Coal Seam Thickness (feet)		Depth (feet)		Area underlain by Coal Formation (sq. miles)	
			Range	Av.	Range	Av.	Total	Area used
WOOD MOUNTAIN-WILLOWBUNCH —*Concluded*								
(3) Wood Mountain Block	....	....	....	......	....	......	800	
	Vogelberg........	230	4.0–11.0	6	0–100	50	....	150
	Anxiety Butte.....		2.0– 4.0	3	0–250	100	....	200
(4) Pinto Butte Block.	....	....	....	......	....	......	100	
	Ferris or No. 1....	....	2.0– 6.0	4	20–100	50	....	20
Total..............	....	....	....	......	....	......	....	......
CYPRESS HILLS.....	....	....	....	......	....	......	900	
(1) Eastend Block.....	....	....	....	......	....	......	800	
	Anxiety Butte.....	100	2.0–12.0	6	0–100	60	....	80
	Ferris or No. 1....		1.0–15.0	3	0–140	70	....	150
(2) Cypress Lake Block	....	....	....	......	....	......	100	
	Ferris or No. 1....	....	1.0– 6.0	3	0–140	70		20
Total..............	....	....	....	......	....	......	....	......
TOTAL SOUTHERN SASKATCHEWAN	....	....	....	......	....	......	....	......
WESTERN SASKATCHEWAN (Upper Cretaceous) Belly River Series....	Not designated							
Maple Creek........	....	....	4.5 7.5	....	200 0–235	....	....	....
Saskatchewan Landing	....	....	4.0	......	Outcrop	......	....	......
Laporte............	....	....	8.0	......	130	......	....	......
Brock..............	....	....	8.0	......	Outcrop	......	....	......
Smiley............	....	....	4.0	......	100	......	....	......
Kelfield...........	....	....	2.0–13.0 0 –13.0	....	0–180 0–150	....	....	....
Luseland...........	....	....	10.0	......	100	......	....	......
Casene............	....	....	10.0	......	300	......	....	......
Evesham..........	....	....	9.0	......	100	......	....	......
Unity.............	....	....	4.0	......	Outcrop	......	....	......
Adanac...........	....	....	5.0	......	250	......	....	......
Phippen..........	....	....	5.0	......	200	......	....	......
Intervening Areas...	....	....	3.0	......	0–500	......	30,000	100
TOTAL WESTERN SASKATCHEWAN...	....	....	....	......	....	......	....	......
GRAND TOTAL..	....	....	....	......	....	......	....	......

3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 500 FEET—*Concluded*
of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)					
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)	
5	50.0	280,000	3	100	336,000	140,000	168,000	
3	100.0	336,000	3	100	336,000	168,000	168,000	
4	10.0	44,800	3	10	33,600	22,400	16,800	
....	....	5,420,800	....	....	3,897,600	2,710,400	1,948,800	
6	50.0	336,000	3	30	100,800	168,000	50,400	
3	69.0	234,000	3	50	168,000	117,000	84,000	
3	10.0	33,600	3	10	33,600	16,800	16,800	
....	....	603,600	....	....	302,400	301,800	151,200	
....	....	13,074,800	....	....	10,600,800	6,537,400	5,300,400	
4	0.5	2,240	3	1	3,360	1,120	1,680	
7	0.5	3,920	5	1	5,600	1,960	2,800	
4	0.5	2,240	3	1	3,360	1,120	1,680	
8	0.5	4,480	5	1	5,600	2,240	2,800	
8	0.5	4,480	5	1	5,600	2,240	2,800	
4	0.5	2,240	3	1	3,360	1,120	1,680	
7	0.5	3,920	3	2	6,720	1,960	3,360	
8	0.5	4,480	3	2	6,720	2,240	3,360	
10	0.5	5,600	5	1	5,600	2,800	2,800	
10	0.5	5,600	5	1	5,600	2,800	2,800	
9	0.5	5,040	5	1	5,600	2,520	2,800	
4	0.5	2,240	3	1	3,360	1,120	1,680	
5	0.5	2,800	3	1	3,360	1,400	1,680	
5	0.5	2,800	3	1	3,360	1,400	1,680	
....	....	....	3	100	336,000	....	168,000	
....	....	52,080	....	....	403,200	26,040	201,600	
....	....	13,126,880	....	....	11,004,000	6,563,440	5,502,000	IV

TABLE 10.—SUMMARY OF RESERVES OF ALBERTA

(Thousands of net tons)

District	Mineable		Recoverable	
	Probable	Possible (Additional)	Probable	Possible (Additional)
Inner Foothills Belt	20,325,760	7,323,680	10,162,880	3,661,840
Outer Foothills Belt	6,582,240	3,531,360	3,291,120	1,765,680
Plains (Belly River Formation)	2,612,940	1,501,920	1,306,470	750,960
Plains (Edmonton Formation)	4,916,800	1,079,600	2,458,400	539,800
Alberta Total	34,437,740	13,436,560	17,218,870	6,718,280

TABLE 11.—RESERVES OF INNER FOOTHILLS BELT, ALBERTA, BASED ON SEAMS

(Thousands

District and Area	Coal-bearing Formation	Area underlain by Coal Formation (sq. miles)		Coal Seams		
		Total	Area used	No.	Aggregate Thickness (feet)	Thickness used (feet)
Crowsnest—						
Coleman	Kootenay	25	25	4	30.0	30
Mutz	"	17	17	3	27.0	27
Blairmore	"	22	19	3	27.0	27
East Flank Bluff-Turtle Mt.	"	11	11	3	25.0	25
Bluff-Mt. N. Extension	"	4	4	3	25.0	2
Bellevue-Lille	"	11	11	3	25.0	25
Hillcrest Basin	"	9	9	3	25.0	25
Bellevue-Burmis and Ext.	"	15	15	3	15.0	15
Beaver Mines	"	33	33	3	14.0	14
Beaver Mines N. Extension	"	6	6	3	14.0	14
North Kootenay Pass	"	11	11	3	15.0	15
Canon Creek	"	4	4	3	25.0	20
Sentinel	Belly River	4	3	1	7.5	5
Total						
Oldman—						
West Oldman River	Kootenay	23	23	3	30.0	30
Pasque Mt. West Flank	"	9	9	3	30.0	30
Pasque Mt. Basin	"	11	11	3	25.0	25
Livingstone River Basin	"	31	31	3	25.0	25
Intervening Anticline	"	11	11	3	25.0	25
Mt. Livingstone N. Basin	"	11	11	3	20.0	20
Mt. Livingstone S. Basin	"	18	18	3	20.0	20
Total						
Highwood—						
Cataract River West	Kootenay	8	8	5	60.0	50
Storm-Mist Creeks	"	10	10	5	60.0	50
Upper Highwood	"	12	12	8	80.0	60
Sheep Creek Basin	"	9	9	12	120.0	70
Cat Creek-Salter Creek	"	13	13	8	100.0	60
Lower Cat Creek	"	4	4	8	100.0	60
Trap Creek West	"	12	12	4	30.0	30
Trap Creek Centre	"	7	7	4	30.0	30
Trap Creek East	"	11	11	4	30.0	30
Missing Link Mt. Basin	"	45	45	3	20.0	15
Wolf-Sheep Creek	Edmonton	6	6	1	3.0	3
Total						
Cascade—						
Upper Kananaskis River	Kootenay	7	5	12	80.0	60
Ribbon Creek-Wind Mt.	"	14	12	8	80.0	70
Canmore	"	12	9	16	116.0	70
Canmore-Anthracite	"	8	5	6	60.0	60
Lower Cascade River	"	9	7	7	60.0	60
Upper Cascade River	"	5	4	4	30.0	30
Moose Mountain	"	30	20	1	6.8	3
Bragg Creek	"	20	10	1	3.0	3
Total						
Panther—						
Vermillion Range Basins	Kootenay	35	20	4	20.0	15
Central Basin	"	11	8	3	15.0	10
Costigan Basin	"	15	12	3	15.0	10
Total						

NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 2,500 FEET of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)			Probable	Possible (Additional)	
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage			
30	22	739,200	30	3	100,800	369,600	50,400	II 2
27	15	453,600	27	2	60,480	226,800	30,240	II 2
27	14	423,360	27	5	151,200	211,680	75,600	II 2
25	10	280,000	25	1	28,000	140,000	14,000	II 2
25	2	56,000	25	2	56,000	28,000	28,000	II 2
25	10	280,000	25	1	28,000	140,000	14,000	II 2
25	6	168,000	25	3	84,000	84,000	42,000	II 2
15	10	168,000	15	5	84,000	84,000	42,000	II 2
14	25	392,000	14	8	125,440	196,000	62,720	II 2
14	4	62,720	14	2	31,360	31,360	15,680	II 2
15	5	84,000	10	6	67,200	42,000	33,600	II 2
20	2	44,800	20	2	44,800	22,400	22,400	II 2
5	1	5,600	5	2	11,200	2,800	5,600	II 3
....	....	3,157,280	....	....	872,480	1,578,640	436,240	
30	20	672,000	30	3	100,800	336,000	50,400	II 2
30	8	268,800	30	1	33,600	134,400	16,800	II 2
25	10	280,000	25	1	28,000	140,000	14,000	II 2
25	26	728,000	25	5	140,000	364,000	70,000	II 2
25	10	280,000	25	1	28,000	140,000	14,000	II 2
20	10	224,000	20	1	22,400	112,000	11,200	II 2
20	16	358,400	20	2	44,800	179,200	22,400	II 2
....	....	2,811,200	....	....	397,600	1,405,600	198,800	
50	5	280,000	50	3	168,000	140,000	84,000	II 1
50	3	168,000	50	7	392,000	84,000	196,000	II 1
60	9	604,800	60	3	201,600	302,400	100,800	II 1
70	7	548,800	70	2	156,800	274,400	78,400	II 1
60	11	739,200	60	2	134,400	369,600	67,200	II 1
60	3	201,600	60	1	67,200	100,800	33,600	II 1
30	10	336,000	30	2	67,200	168,000	33,600	II 2
30	6	201,600	30	1	33,600	100,800	16,800	II 2
30	5	168,000	30	6	201,600	84,000	100,800	II 2
15	30	504,000	15	15	252,000	252,000	126,000	II 2
3	3	10,080	3	3	10,080	5,040	5,040	II 3
....	....	3,762,080	....	....	1,684,480	1,881,040	842,240	
60	4	268,800	60	1	67,200	134,400	33,600	II 1, I 2, I 3
70	10	784,000	70	2	156,800	392,000	78,400	II 1
70	6	470,400	30	3	100,800	235,200	50,400	II 1
60	4	268,800	60	1	67,200	134,400	33,600	II 1
60	5	336,000	60	2	134,400	168,000	67,200	II 1
30	3	100,800	30	1	33,600	50,400	16,800	II 1
....	....	....	3	20	67,200	....	33,600	II 2
....	....	....	3	10	33,600	....	16,800	II 2
....	....	2,228,800	....	....	660,800	1,114,400	330,400	
15	15	252,000	15	5	84,000	126,000	42,000	II 1 and II 2
10	6	67,200	10	2	22,400	33,600	11,200	II 2
10	10	112,000	10	2	22,400	56,000	11,200	II 1
....	....	431,200	....	....	128,800	215,600	64,400	

TABLE 11.—RESERVES OF INNER FOOTHILLS BELT, ALBERTA, BASED ON SEAMS —*Con*

(Thousands

District and Area	Coal-bearing Formation	Area underlain by Coal Formation (sq. miles)		Coal Seams		
		Total	Area used	No.	Aggregate Thickness (feet)	Thickness used (feet)
Clearwater—						
Cripple Creek Sheet	Luscar	20	20	3	15.0	10
Hummingbird Creek Basins	Kootenay	15	12	2	7.0	6
Upper Clearwater	"	20	10	2	7.0	7
Scalp Creek Basin	"	3	1	2	10.0	5
Total						
Nordegg—						
Alexo	Luscar	45	45	3	20.0	10
Brazeau	"	35	35	2	19.0	15
Bighorn	"	24	14	8	60.0	50
George Creek	"	12	12	8	70.0	60
Wapaibi Creek	"	2	2	2	19.0	10
Wawa Creek	"	5	5	2	19.0	10
Total						
Mountain Park—						
George Creek and Ext	Luscar	10	10	8	50.0	30
Grave Flats	"	15	10	3	30.0	20
Mountain Park	"	18	18	7	77.0	70
Cadomin-Luscar and Ext	"	30	30	3	35.0	35
Medicine Lake	"	7	5	5	50.0	40
Total						
Brule—						
Athabaska River South	Luscar	8	7	4	25.0	20
Brule and North Ext	"	33	22	4	25.0	25
Pocahontas-Moose Creek	"	16	8	3	27.0	25
Wildhay River-Thoreau Ck	"	12	8	3	54.0	50
Total						
Smoky River—						
Thoreau Creek North Ext	Luscar	26	26	3	54.0	30
Upper Sheep-Smoky River	"	30	30	3	30.0	15
Old Smoky River Reserve	"	45	45	5	35.0	35
Muskeg-Wildhay River	"	20	20	3	25.0	20
Total						
GRAND TOTAL						

NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 2,500 FEET
tinued

of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)					
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)	
10	15	168,000	10	5	56,000	84,000	28,000	II 2
3	5	16,800	3	7	23,520	8,400	11,760	II 2
7	5	39,200	7	5	39,200	19,600	19,600	II 2
....	....	....	5	1	5,600	....	2,800	II 1 and II 2
....	....	224,000	....	....	124,320	112,000	62,160	
10	25	280,000	10	20	224,000	140,000	112,000	II 1
15	20	336,000	15	15	252,000	168,000	126,000	II 1
50	10	560,000	50	4	224,000	280,000	112,000	II 2
60	10	672,000	60	2	134,400	336,000	67,200	II 2
....	....	....	10	2	22,400	....	11,200	II 1
10	4	44,800	10	1	11,200	22,400	5,600	II 1
....	....	1,892,800	....	....	868,000	946,400	434,000	
30	9	302,400	30	1	33,600	151,200	16,800	II 2
20	8	179,200	20	2	44,800	89,600	22,400	II 2
70	15	1,176,000	70	3	235,200	588,000	117,600	II 2 and II 3
35	25	980,000	35	5	196,000	490,000	98,000	II 2
40	4	179,200	40	1	44,800	89,600	22,400	II 2
....	....	2,816,800	....	....	554,400	1,408,400	277,200	
20	4	89,600	20	3	67,200	44,800	33,600	II 1 and II 2
25	13	364,000	25	9	252,000	182,000	126,000	II 1 and II 2
25	3	84,000	25	5	140,000	42,000	70,000	II 1
50	4	224,000	50	4	224,000	112,000	112,000	II 1 and II 2
....	....	761,600	....	....	683,200	380,800	341,600	
30	20	672,000	30	6	201,600	336,000	100,800	II 1
15	5	84,000	15	25	420,000	42,000	210,000	II I
35	35	1,372,000	35	10	392,000	686,000	196,000	II 1
20	5	112,000	20	15	336,000	56,000	168,000	II 1 and II 2
....	....	2,240,000	....	....	1,349,600	1,120,000	674,800	
....	....	20,325,760	....	....	7,323,680	10,162,880	3,661,840	

TABLE 12.—RESERVES OF OUTER FOOTHILLS BELT. ALBERTA, BASED ON SEAMS

(Thousands

District	Coal-bearing Formation	Area underlain by Coal Formation (sq. miles)		Coal Seams		
		Total	Area used	No.	Aggregate Thickness (feet)	Thickness used (feet)
Pincher	St. Mary River	80	40	1	3	3
	Belly River	300	20	2	10	10
Total						
Pekisko	St. Mary River	70	40	3	12	10
	Belly River	250	70	2	13	10
	Kootenay	10	8	2	10	10
Total						
Morley	Edmonton	100	50	1	3	3
	Belly River	425	100	2	10	5
	Kootenay	30	30	2	10	6
Total						
Red Deer	Paleocene	550	10	1	5	3
	Edmonton	32	20	1	3	3
	Brazeau	200	50	1	3	3
	Luscar	126	60	3	16	10
Total						
Mountain House	Paleocene	Insufficient data	10	1	5	4
Total						
Saunders	Saunders	500	125	3	20	15
	Brazeau	85	10	1	3	3
	Luscar	14	3	3	10	5
Total						
Coalspur	Saunders	400	125	3	30	30
	Brazeau	350	10	1	5	3
Total						
Prairie Creek	Saunders	350	34	3	15	10
	Brazeau	150	10	1	3	3
Total						
Grand Total						

NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 2,500 FEET

of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)					
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)	
3	20	67,200	3	20	67,200	33,600	33,600	II 4
10	8	89,600	10	12	134,400	44,800	67,200	II 3 and II 5
....	....	156,800	....	....	201,600	78,400	100,800	
10	20	224,000	10	20	224,000	112,000	112,000	II 4
10	40	448,000	10	30	336,000	224,000	168,000	II 4
10	5	56,000	10	3	33,600	28,000	16,800	II 4
....	....	728,000	....	....	593,600	364,000	296,800	
3	20	67,200	3	30	100,800	33,600	50,400	II 4
5	25	140,000	5	75	420,000	70,000	210,000	II 4
6	25	168,000	6	5	33,600	84,000	16,800	II 4
....	....	375,200	....	....	554,400	187,600	277,200	
....	....	....	3	10	33,600	....	16,800	II 5
3	5	16,800	3	15	50,400	8,400	25,200	II 4
3	20	67,200	3	30	100,800	33,600	50,400	II 4
10	30	336,000	10	30	336,000	168,000	168,000	II 2
....	....	420,000	....	....	520,800	210,000	260,400	
4	2	8,960	4	8	35,840	4,480	17,920	II 5
....	....	8,960	....	....	35,840	4,480	17,920	
15	75	1,260,000	15	50	840,000	630,000	420,000	II 5
3	3	10,080	3	7	23,520	5,040	11,760	II 4
5	1	5,600	5	2	11,200	2,800	5,600	II 2
....	....	1,275,680	....	....	874,720	637,840	437,360	
30	100	3,360,000	20	25	560,000	1,680,000	280,000	II 5
3	5	16,800	3	5	16,800	8,400	8,400	II 4
....	....	3,376,800	....	....	576,800	1,688,400	288,400	
10	20	224,000	10	14	156,800	112,000	78,400	II 5
3	5	16,800	3	5	16,800	8,400	8,400	II 4
....	....	240,800	....	....	173,600	120,400	86,800	
....	....	6,582,240	....	....	3,531,360	3,291,120	1,765,680	

TABLE 13.—RESERVES OF ALBERTA PLAINS (MAINLY BELLY RIVER SERIES) BASED

1,000

(Thousands

District	Coal-bearing Formation	Area underlain by Coal Formation (sq. miles)		Coal Seams		
		Total	Area used	No.	Aggregate Thickness (feet)	Thickness used (feet)
Magrath	St. Mary River (Edmonton)	250	40	1	6	5.0
	Oldman	140	41	2	7	6.0
Total						
Lethbridge	St. Mary River (Edmonton)	75	5	1	3	3.0
	Oldman	270	180	2	7	4.0
Total						
Milk River	St. Mary River (Edmonton)	75	5	1	3	3.0
	Oldman	540	60	1	5	3.0
	Foremost	1,360	130	1	4	3.5
Total						
Pakowki	Ravenscrag	90	1	1	3	3.0
	Eastend (Edmonton)	185	10	2	10	6.0
	Oldman	850	15	1	6	6.0
	Foremost	400	30	1	7	5.0
Total						
Taber	Oldman	1,300	15	1	4	3.0
	Foremost	2,000	150	1	4	3.5
Total						
Redcliff	Oldman	1,300	12	1	Inferred	3.0
	Foremost	130	20	1	6	4.0
Total						
Brooks	Edmonton	79	11	1	Inferred	3.0
	Oldman	1,500	80	1	Inferred	4.0
	Foremost	50	60	1	5	4.0
Total						
Steveville	Edmonton	40	5	1	Inferred	3.0
	Oldman	325	10	1	4	3.0
Total						

ON SEAMS NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF FEET

of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)			Probable	Possible (Additional)	
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage			
5.0	35	196,000	3.0	5	16,800	98,000	8,400	II 5
6.0	36	241,900	4.0	5	22,400	120,950	11,200	II 3 and II 4
....	....	437,900	....	....	39,200	218,950	19,600	
3.0	2	6,720	3.0	3	10,080	3,360	5,040	II 5
4.0	150	672,000	4.0	30	134,400	336,000	67,200	
....	....	678,720	....	....	144,480	339,360	72,240	
3.0	1	3,360	3.0	4	13,440	1,680	6,720	III 1
3.0	10	33,600	3.0	50	168,000	16,800	84,000	III 1 and III 2
3.5	100	392,000	3.0	30	100,800	196,000	50,400	III 1 and III 2
....	....	428,960	....	....	282,240	214,480	141,120	
....	....	....	3.0	1	3,360	....	1,680	IV
6.0	7	47,040	6.0	3	20,160	23,520	10,080	III 3
6.0	10	67,200	3.0	5	16,800	33,600	8,400	III 3
5.0	25	140,000	3.0	5	16,800	70,000	8,400	III 3
....	....	254,240	....	....	57,120	127,120	28,560	
3.0	5	16,800	3.0	10	33,600	8,400	16,800	III 1 and III 2
3.5	100	392,000	3.5	50	196,000	196,000	98,000	III 1 and III 2
....	....	408,800	....	....	229,600	204,400	114,800	
3.0	2	6,720	3.0	10	33,600	3,360	16,800	III 3
4.0	10	44,800	4.0	10	44,800	22,400	22,400	III 3
....	....	51,520	....	....	78,400	25,760	39,200	
3.0	1	3,360	3.0	10	33,600	1,680	16,800	III 2
4.0	30	134,400	4.0	50	224,000	67,200	112,000	III 2
4.0	10	44,800	3.0	50	168,000	22,400	84,000	III 2
....	....	182,560	....	....	425,600	91,280	212,800	
3.0	1	3,360	3.0	4	13,440	1,680	6,720	III 2 and III 3
3.0	4	13,440	3.0	6	20,160	6,720	10,080	III 2 and III 3
....	....	16,800	....	....	33,600	8,400	16,800	

TABLE 13.—RESERVES OF ALBERTA PLAINS (MAINLY BELLY RIVER SERIES) BASED
1,000 FEET

(Thousands

District	Coal-bearing Formation	Area underlain by Coal Formation (sq. miles)		Coal Seams		
		Total	Area used	No.	Aggregate Thickness (feet)	Thickness used (feet)
Empress	Oldman	1,700	5	1	Inferred	3.0
	Foremost	30	10	1	3	3.0
Total						
Wainwright	Oldman	925	3	1	3	3.0
	Ribstone Creek (Foremost)	30	5	1	Inferred	3.0
Total						
Pakan	Oldman	1,200	5	1	3	3.0
	Ribstone Creek (Foremost)	1,000	5	1	Inferred	3.0
Total						
Westlock	Edmonton	360	10	1	6	5.0
	Oldman	1,300	10	1	5	3.0
Total						
Rochester	Oldman	540	5	1	Inferred	3.0
	Ribstone Creek (Foremost)	470	5	1	3	3.0
Total						
Slave	Edmonton	360	3	1	Inferred	3.0
	Oldman	900	5	1	4	3.0
Total						
High Prairie	Edmonton	900	5	1	Inferred	3.0
	Oldman	1,600	5	1	4	4.0
Total						
Sexsmith	Edmonton	260	4	1	3	3.0
	Oldman	1,600	5	1	3	3.0
Total						
Valhalla	Edmonton	325	5	1	Inferred	3.0
	Oldman	1,340	10	1	3	3.0
Total						
GRAND TOTAL						

ON SEAMS NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF —*Concluded*

of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)					
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)	
3.0	1	3,360	3.0	4	13,440	1,680	6,720	III 3
3.0	5	16,800	3.0	5	16,800	8,400	8,400	III 3
....	....	20,160	....	....	30,240	10,080	15,120	
3.0	1	3,360	3.0	2	6,720	1,680	3,360	III 3
3.0	1	3,360	3.0	4	13,440	1,680	6,720	III 3
....	....	6,720	....	....	20,160	3,360	10,080	
3.0	2	6,720	3.0	3	10,080	3,360	5,040	III 3
3.0	2	6,720	3.0	3	10,080	3,360	5,040	III 3
....	....	13,440	....	....	20,160	6,720	10,080	
5.0	3	16,800	3.0	7	23,520	8,400	11,760	III 3
3.0	3	10,080	3.0	7	23,520	5,040	11,760	III 3
....	....	26,880	....	....	47,040	13,440	23,520	
3.0	2	6,720	3.0	3	10,080	3,360	5,040	III 2 and III 3
3.0	2	6,720	3.0	3	10,080	3,360	5,040	III 2 and III 3
....	....	13,440	....	....	20,160	6,720	10,080	
3.0	1	3,360	3.0	2	6,720	1,680	3,360	III 3
3.0	2	6,720	3.0	3	10,080	3,360	5,040	III 3
....	....	10,080	....	....	16,800	5,040	8,400	
3.0	2	6,720	3.0	3	10,080	3,360	5,040	III 3
4.0	2	8,960	4.0	3	13,440	4,480	6,720	III 3
....	....	15,680	....	....	23,520	7,840	11,760	
3.0	2	6,720	3.0	2	6,720	3,360	3,360	III 3
3.0	3	10,080	3.0	2	6,720	5,040	3,360	III 3
....	....	16,800	....	....	13,440	8,400	6,720	
3.0	3	10,080	3.0	2	6,720	5,040	3,360	III 3 and III 2
3.0	6	20,160	3.0	4	13,440	10,080	6,720	III 3 and III 2
....	....	30,240	....	....	20,160	15,120	10,080	
....	....	2,612,940	....	....	1,501,920	1,306,470	750,960	

TABLE 14.—RESERVES OF ALBERTA PLAINS (EDMONTON FORMATION) BASED ON 1,000

(Thousands

District	Formation	Area underlain by Coal Formation (sq. miles)		Name and No. of Seam	Coal Seam Thickness (feet)	
		Total	Area used		Range	Av.
Champion.............	Edmonton.......	950	25	Insufficient data.....	2.0– 4.0	3.0
Gleichen...............	Edmonton.......	1,350	20	Insufficient data.....	2.0– 4.5	3.5
Drumheller............	Edmonton.......	400	15	No. 11 or Carbon....	1.0– 3.0	3.0
			35	No. 7................	1.0– 6.5	4.0
			100	No. 5 or Top........	3.0– 5.5	4.5
			55	No. 2................	2.0– 6.0	4.0
			80	No. 1 or Deep.......	4.0– 7.0	5.5
Total.........	....	....	....	....	....	.....
Sheerness.............	Edmonton.......	1,225	30	No. 1................	4.0– 7.0	6.0
			23	No. 6................	0.5– 4.0	3.0
Total.........	....	....	....	....	....	.....
Carbon................	Edmonton.......	500	35	No. 11 or Carbon....	2.0– 5.0	4.0
			35	No. 14 or Ardley....	4.0– 6.0	5.0
Total.........	....	....	....	....	....	.....
Big Valley............	Edmonton.......	360	15	No. 12 or Thompson.	4.0– 6.0	5.5
			15	No. 11 or Carbon....	2.0– 4.0	3.0
Total.........	....	....	....	....	....	.....
Castor................	Edmonton.......	2,550	54	Main.................	3.0–10.0	6.0
			14	Lower................	3.0– 8.0	5.0
Total.........	....	....	....	....	....	.....

COAL SEAMS NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF FEET

of net tons)

Mineable						Recoverable		
Probable			Possible (Additional)					A.S.T.M Classification
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)	
3.0	20	67,200	3.0	5	16,800	33,600	8,400	III 1 and III 2
3.5	15	58,800	3.0	5	16,800	29,400	8,400	III 2
3.0	10	33,600	3.0	5	16,800	16,800	8,400	III 2
3.5	25	98,000	3.5	10	39,200	49,000	19,600	
3.5	80	313,600	3.5	20	78,400	156,800	39,200	
4.0	40	179,200	4.0	15	67,200	89,600	33,600	
5.5	60	369,600	5.5	20	123,200	184,800	61,600	
....	....	994,000	....	....	324,800	497,000	162,400	
6.0	25	168,000	3.0	5	16,800	84,000	8,400	III 3
3.0	20	67,200	3.0	3	10,080	33,600	5,040	
....	....	235,200	....	....	26,880	117,600	13,440	
4.0	30	134,400	4.0	5	22,400	67,200	11,200	III 2 and III 1
5.0	30	168,000	5.0	5	28,000	84,000	14,000	
....	....	302,400	....	....	50,400	151,200	25,200	
5.0	10	56,000	5.0	5	28,000	28,000	14,000	III 2
3.0	10	33,600	3.0	5	16,800	16,800	8,400	
....	....	89,600	....	....	44,800	44,800	22,400	
5.0	50	280,000	3.0	4	13,400	140,000	6,700	III 3 and III 2
5.0	10	56,000	3.0	4	13,400	28,000	6,700	
....	....	336,000	....	....	26,800	168,000	13,400	

TABLE 14.—RESERVES OF ALBERTA PLAINS (EDMONTON FORMATION) BASED ON 1,000 FEET

(Thousands

District	Formation	Area underlain by Coal Formation (sq. miles)		Name and No. of Seam	Coal Seam Thickness (feet)	
		Total	Area used		Range	Av.
Ardley	Edmonton	250	28	No. 14 or Ardley	5.0- 6.0	5.5
			28	Carbon	4.0- 6.0	5.0
Total						
Wetaskiwin	Edmonton	1,000	15	Insufficient data	4.0- 7.0	5.0
Camrose	Edmonton	825	17	Upper	4.0- 7.0	5.0
			8	Lower	No data	5.0
Total						
Tofield	Edmonton	350	25	Upper	5.0- 8.0	6.5
			25	Lower	4.0- 7.0	5.0
Total						
Edmonton	Edmonton	1,875	50	No. 9 or Big Island	2.0- 5.0	3.0
			50	No. 7 or Weaver	No data	6.0
			35	No. 4 or Clover Bar	4.0- 6.0	5.0
			31	No. 3 or Lower	1.0- 5.0	3.0
Total						
Pembina	Edmonton	1,750	55	Big Seam	4.0-25.0	20.0
			50	Lower	4.0- 7.0	5.0
Total						
Whitecourt	Edmonton	540	20	Insufficient data	3.0- 6.0	5.0
Halcourt (South Extension)	Edmonton	940	75	Insufficient data	1.0- 4.0	3.5
GRAND TOTAL						

COAL SEAMS NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF
—*Concluded*

of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)					
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)	
5.0	25	140,000	3.0	3	10,080	70,000	5,040	III 2
5.0	25	140,000	3.0	3	10,080	70,000	5,040	
....	....	280,000	....	....	20,160	140,000	10,080	
5.0	10	56,000	5.0	5	28,000	28,000	14,000	III 2
5.0	15	84,000	3.0	2	6,720	42,000	3,360	III 3 and III 2
5.0	5	28,000	3.0	3	10,080	14,000	5,040	
....	....	112,000	....	....	16,800	56,000	8,400	
6.0	20	134,400	3.0	5	16,800	67,200	8,400	III 3
5.0	20	112,000	3.0	5	16,800	56,000	8,400	
....	....	246,400	....	....	33,600	123,200	16,800	
3.0	40	134,400	3.0	10	33,600	67,200	16,800	III 2 and III 3
5.0	40	224,000	5.0	10	56,000	112,000	28,000	
5.0	30	168,000	5.0	5	28,000	84,000	14,000	
3.0	30	100,800	3.0	1	3,360	50,400	1,680	
....	....	627,200	....	....	120,960	313,600	60,480	
20.0	45	1,008,000	20.0	10	224,000	504,000	112,000	III 2
5.0	45	252,000	5.0	5	28,000	126,000	14,000	
....	....	1,260,000	....	....	252,000	630,000	126,000	
5.0	15	84,000	3.0	5	16,800	42,000	8,400	III 2
3.0	50	168,000	3.0	25	84,000	84,000	42,000	II 5 and III 2
....	....	4,916,800	....	....	1,079,600	2,458,400	539,800	

TABLE 15.—SUMMARY OF RESERVES OF BRITISH COLUMBIA

(Thousands of net tons)

District	Mineable		Recoverable	
	Probable	Possible (Additional)	Probable	Possible (Additional)
Southeastern British Columbia	10,334,388	4,541,600	5,167,194	2,270,800
Northeastern British Columbia	467,040	573,440	233,520	286,720
Central British Columbia	559,440	565,040	279,720	282,520
Northern British Columbia	....	138,880	....	69,440
South Central British Columbia	278,880	163,520	139,440	81,760
Vancouver Island, B.C.	52,692	349,836	26,346	174,918
Graham Island, B.C.	103,040	702,240	51,520	351,120
British Columbia Total	11,795,480	7,034,556	5,897,740	3,517,278

TABLE 16.—RESERVES OF SOUTHEASTERN BRITISH COLUMBIA, BASED ON

(Thousands

District and Area	Coal-bearing Formation	Area underlain by Coal Formation (sq. miles)		Coal Seams			Depth (feet) Range
		Total	Area used	No.	Aggregate Thickness (feet)	Thickness used (feet)	
Crowsnest Coal Areas—							
Fernie Basin................	Kootenay.....	230	....	......	....	....	1–2,500
Michel Block..............	"	12	12.0	18	170	70	
Coal Creek................	"	4	2.0	23	170	150	
North End................	"	10	10.0	18	170	150	
Western rim...............	"	16	16.0	23	170	170	
Eastern rim...............	"	15	15.0	8	130	130	
Sub-total.............	....	....	....	.....	....	....	....
Corbin Basin.....	Kootenay.....	3	1.3	2	60	60	1-1,000
Taylor and Tent Mountains..	Kootenay.....	6	5.0	2	60	50	1–1,000
Total.................	....	....	....	.....	....	....	....
Flathead River................	Kootenay......	10	6.0	5	80	50	0–1,000
Upper Elk River—							
Alexander Creek and Forks..	Kootenay......	4	2.0	12	80	80	1–2,500
Crown Mountain.............	"	4	3.0	8	65	60	
Kilmarnock (Lewis) R.......	"	40	25.0	10	80	60	
Greenhills..................	"	18	18.0	10	97	70	
Mt. Marpole to Kilmarnock R.	"	20	10.0	18	170	150	
Aldridge Creek North.......	"	15	10.0	10	150	75	
Sub-total.............	....	....	....	.....	....	....	....
GRAND TOTAL..........	....	....	....	.....	....	....	....

TABLE 17.—RESERVES OF NORTHEASTERN BRITISH COLUMBIA, BASED ON

(Thousands

District and Area	Coal-bearing Formation	Area underlain by Coal Formation (sq. miles)		Coal Seams		
		Total	Area used	No.	Aggregate Thickness (feet)	Thickness used (feet)
Peace River Canyon—						
Gething-Johnson Creek and Ext.....	Gething Lower	8	8	8	28	20
Moosecall Lake North.............	Cretaceous	6	6	4	15	10
Butler Ridge—						
Packwood North Extension.........	"	25	15	7	24	20
East Flank.........................	"	20	15	4	15	10
Carbon River........................	"	10	10	5	15	10
Falls Creek.........................	"	10	5	2	10	10
Hasler Creek-Willow Creek..........	"	18	7	2	25	12
Halfway-Sikanni Chief Rivers........	"	10	5	1	5	5
Minaker River.......................		Insufficient data as to thickness				
Total....................	....	....	....	.....	....	....

SEAMS NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 2,500 FEET

of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)			Probable	Possible (Additional)	
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage			
....	....	....	....	....	....	....	....	II 2
70	10.0	784,000	70	2	156,800	392,000	78,400	
150	1.0	168,000	150	1	168,000	84,000	84,000	
150	8.0	1,344,000	150	2	336,000	672,000	168,000	
170	12.0	2,284,800	170	4	761,600	1,142,400	380,800	
130	12.0	1,747,200	130	3	436,800	873,600	218,400	
....	....	6,328,000	....	....	1,859,200	3,164,000	929,600	
60	1.3	81,588	....	....	....	40,794	....	II 2
50	4.0	224,000	50	1	56,000	112,000	28,000	II 2
....	....	6,633,588	....	....	1,915,200	3,316,794	957,600	
50	3.0	168,000	50	3	168,000	84,000	84,000	II 2
								II 2
80	1.0	89,600	80	1	89,600	44,800	44,800	
60	1.0	67,200	60	2	134,400	33,600	67,200	
60	15.0	1,008,000	60	10	672,000	504,000	336,000	
70	12.0	940,000	70	6	470,400	470,000	235,200	
150	5.0	840,000	150	5	840,000	420,000	420,000	
75	7.0	588,000	75	3	252,000	294,000	126,000	
....	....	3,532,800	....	....	2,458,400	1,766,400	1,229,200	
....	....	10,334,388	....	....	4,541,600	5,167,194	2,270,800	

SEAMS NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 2,500 FEET

of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)			Probable	Possible (Additional)	
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage			
								II 1
20	6	134,400	20	2	44,800	67,200	22,400	
10	3	33,600	10	3	33,600	16,800	16,800	
20	5	112,000	20	10	224,000	56,000	112,000	
10	5	56,000	10	10	112,000	28,000	56,000	
10	6	67,200	10	4	44,800	33,600	22,400	
10	3	33,600	10	2	22,400	16,800	11,200	
12	1	13,440	12	6	80,640	6,720	40,320	
5	3	16,800	5	2	11,200	8,400	5,600	
....	....	467,040	....	....	573,440	233,520	286,720	

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TABLE 18.—RESERVES OF CENTRAL BRITISH COLUMBIA, BASED ON SEAMS

(Thousands

District and Area	Coal-bearing Formation	Area underlain by Coal Formation (sq. miles)		Coal Seams		
		Total	Area used	No.	Aggregate Thickness (feet)	Thickness used (feet)
Skeena River Drainage Basin—	Skeena Series					
Telkwa	Lower Creta-	6	2.7	3	25	20
Clark-Fork	ceous	3	3.0	3	15	15
Chisholm Lake	"	Insufficient data as to thickness and extent				
Kathlyn Lake	"	18	6.0	2	7	4
Zymoetz River	"	1	1.0	1	3	3
Kispiox	"	13	4.0	1	5	3
Groundhog	"	40	40.0	4	20	20
Coal Creek	"	3	3.0	4	19	10
Gold Stream	"	3	2.0	2	9	5
Seaton	"	4	1.0	1	4	3
Fraser River Drainage Basin—						
Bowron River	Tertiary	10	5.0	3	21	10
Fort George	"					
Fraser Lake	"					
Nechako River	"					
Blackwater	"					
Quesnel	"					
Cottonwood	"	Insufficient data as to thickness and extent				
Alexandria	"					
Driftwood	"					
Coast Range Area—						
Kohasganko	Tertiary					
Bella Coola	"					
Total						

TABLE 19.—RESERVES OF NORTHERN BRITISH COLUMBIA BASED ON SEAMS

(Thousands

District and Area	Coal-bearing Formation	Area underlain by Coal Formation (sq. miles)		Coal Seams			Depth (feet) Range
		Total	Area used	No.	Aggregate Thickness (feet)	Thickness used (feet)	
Atlin District	Lower	Insufficient data					0–500
Tuya River	Cretaceous			3	100+	100	
Taku River	"			1		4	
Inklin River	"			1	Unexplored	Float	
Skoko River	"			1		Float	
Graham Inlet	"			1		Float	
Liard River Drainage Basin—	Tertiary	Insufficient data				Insufficient data	
Coal River	"			1			
Hyland River	"			1			
Dease River	"			1			
Rapid River	"			1			
Total							

NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 2,500 FEET

of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)					
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)	
20	0.2	4,480	20	2.5	56,000	2,240	28,000	II 3
15	2.0	33,600	15	1.0	16,800	16,800	8,400	II 3
of seams.								
4	3.0	13,440	4	3.0	13,440	6,720	6,720	II 1 and I 1
3	0.5	1,680	3	0.5	1,680	840	840	II 1
3	1.0	3,360	3	3.0	10,080	1,680	5,040	II 2
20	20.0	448,000	20	20.0	448,000	224,000	224,000	II 1 and I 3
10	0.25	2,800	10	0.05	560	1,400	280	II 3
5	1.0	5,600	5	1.0	5,600	2,800	2,800	II 3
3	0.5	1,680	3	0.5	1,680	840	840	II 3
10	4.0	44,800	10	1.0	11,200	22,400	5,600	II 5
of seams.								
....	....	559,440	....	....	565,040	279,720	282,520	

NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 1,000 FEET

of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)					
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)	
....	....	....	100	1.0	112,000	....	56,000	II 5
....	....	....	4	1.0	4,480	....	2,240	II 5
....	....	....	3	1.0	3,360	....	1,680	II 5
....	....	....	3	1.0	3,360	....	1,680	II 5
....	....	....	3	1.0	3,360	....	1,680	II 5
....	....	....	10	0.5	5,600	....	2,800	IV
....	....	....	3	1.0	3,360	....	1,680	IV
....	....	....	3	0.5	1,680	....	840	IV
....	....	....	3	0.5	1,680	....	840	IV
....	....	....	....	....	138,880	....	69,440	

TABLE 20.—RESERVES OF SOUTH CENTRAL BRITISH COLUMBIA BASED ON SEAMS
(Thousands

District	Coal-bearing Formation	Area Underlain by Coal Formation (sq. miles)		Coal Seams		
		Total	Area used	No.	Aggregate Thickness (feet)	Thickness used (feet)
Princeton	Tertiary	6	6	4	20	20
Tulameen	"	5	5	3	25	15
Merritt-Nicola	"	25	10	4	10	8
Quilchena	"	3	2	5	15	10
White Lake	"	Insufficient data as to thickness and extent				
Okanagan Falls	"					
Northern Okanagan Lake	"					
Hat Creek	"	3	1	3	456	100
Kamloops	"	Insufficient data as to thickness and extent				
Chu Chua (North Thompson River)	"					
Total	......	......	......	......	......	......

TABLE 21.—RESERVES OF VANCOUVER ISLAND, BRITISH COLUMBIA, BASED ON
(Thousands

District and Area	Name of Seam	Mine		
		Probable		
		Thickness used (feet)	Area (acres)	Tonnage
Nanaimo Coalfield—				
No. 10 Mine	Douglas	6.0	93	976
South of Granby Mine	"	6.0	50	526
Cedar	"	......	......	......
Chase River	Newcastle	......	......	......
Departure Bay	Wellington	......	......	......
Little Ash Mine	Newcastle	5.0	4	34
White Rapids Mine	"	3.0	138	724
White Rapids Mine	"	2.5	11	48
Total	......	......	......	2,308
Comox Coalfield—				
Cumberland Area				
No. 5 Mine	No. 2	2.6	119	522
No. 8 Mine	No. 2	3.0	750	3,936
No. 8 Mine	No. 4	4.0	520	3,640
To dip of mine workings	No. 2	3.5	1,100	6,738
	No. 4	5.0	1,264	11,060
	All seams	......	......	......
Total	......	......	......	25,896
Tsable River				
Upper Portion of Field	No. 4	2.6	241	1,092
	No. 3	3.4	336	1,940
	No. 2	6.2	485	5,262
Lower Portion of Field	No. 2	11.3	316	6,248
Remainder of Field	All Seams	......	......	......
Total	......	......	......	14,542
Dove Creek and Brown's River	Seams not designated	......	......	......
Tsolum River		......	......	......
Quinsam		4.0	770	5,396
Campbell River		4.0	650	4,550
Total	......	......	......	9,946
Grand Total	......	......	......	52,692

NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 1,000 FEET
of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)					
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)	
20	4.0	89,600	20	2.0	44,800	44,800	22,400	IV, III 1 and III 2
15	3.0	50,400	15	2.0	33,600	25,200	16,800	II 4
8	8.0	71,680	8	2.0	17,920	35,840	8,960	II 4
10	1.0	11,200	10	1.0	11,200	5,600	5,600	II 4
of seams.								
100	0.5	56,000	100	0.5	56,000	28,000	28,000	IV
of seams.								
....	....	278,880	....	....	163,520	139,440	81,760	

SEAMS NOT LESS THAN 2 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 2,000 FEET
of net tons)

able					A.S.T.M. Classification
Possible (Additional)			Recoverable		
Thickness used (feet)	Area (acres)	Tonnage	Probable	Possible (Additional)	
....	....	....	488		II 3
6.0	150	1,574	263	787	
5.0	6,592	57,680	....	28,840	
2.0	70	246	....	123	
2.0	177	620	....	310	
....	....	....	17		
....	....	....	362		
2.6	85	372	24	186	
....	....	60,492	1,154	30,246	
					II 3
....	....	....	261		
....	....	....	1,968		
....	....	....	1,820		
....	....	....	3,369		
....	....	....	5,530		
6.0	5,642	59,240	....	29,620	
....	....	59,240	12,948	29,620	
					II 3
....	....	....	546		
....	....	....	970		
....	....	....	2,631		
....	....	....	3,124		
8.0	4,411	61,754	....	30,877	
....	....	61,754	7,271	30,877	
3.5	1,200	7,350	....	3,675	II 3
4.0	11,520	80,640	....	40,320	
4.0	4,480	31,360	2,698	15,680	
4.0	7,000	49,000	2,275	24,500	
....	....	168,350	4,973	84,175	
....	....	349,836	26,346	174,918	

TABLE 22.—RESERVES OF GRAHAM ISLAND, BRITISH COLUMBIA, BASED ON SEAMS NOT LESS THAN 2 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 2,500 FEET

(Thousands of net tons)

District and Area	Coal-bearing Formation	Area underlain by Coal Formation (sq. miles)		Coal Seams			Depth (feet) Range	Mineable						Recoverable		A.S.T.M. Classification
								Probable			Possible (Additional)					
		Total	Area used	No.	Range (feet)	Thickness used (feet)		Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)	
Southern Portion—	Upper Cretaceous Haida Formation						0-2000									II 1
Honna River Basin Cowgitz..........	"	1	1	2	2.5– 6	6		6	0.5	3,360	6	0.5	3,360	1,680	1,680	
Slatechuck Creek...	"	2	2	3	5.0– 6	10		10	1.0	11,200	10	1.0	11,200	5,600	5,600	
Camp Robertson ..	"	3	3	1	4.0-10	5		5	2.0	11,200	5	1.0	5,600	5,600	2,800	
Camp Anthracite South...........	"	3	2	1	0– 9	4		4	1.0	4,480	4	1.0	4,480	2,240	2,240	
Yakoun River Basin Camp Wilson.......	"	10	2	1	4.0–18 (Av. 12)	5		5	1.0	5,600	5	1.0	5,600	2,800	2,800	
Northern Portion—																
Skonum Point Basin..	Tertiary.......	30	22	10	1.0–15	30		30	2.0	67,200	30	20.0	672,000	33,600	336,000	IV
Total..........	....	......	......	....	....	......	......	......	......	103,040	......	......	702,240	51,520	351,120	

TABLE 23.—RESERVES OF YUKON TERRITORY, BASED ON SEAMS NOT

(Thousands

District and Area	Coal-bearing Formation	Area underlain by Coal Formation (sq. miles)		Coal Seams		
		Total	Area used	No.	Aggregate Thickness (feet)	Thickness used (feet)
Whitehorse district—						
Fish Lake	Lower Cretaceous	....	5.0	3	22	15
Wheaton	"	2	1.0	3	10	8
Total	....	....	....	....	....	....
Laberge District—						
Big Salmon	Lower Cretaceous	45	15.0	2	11	8
Claire Creek	"	4	2.0	1	3	3
Cassiar Bar	"	....	Insufficient data as to thickness			
Hootalinqua	"	....	Insufficient data as to thickness			
Mason Landing	"	....	Insufficient data as to thickness			
Kynocks	"	8	4.0	2	11	8
Total	....	....	....	....	....	....
Carmacks District—						
Five Fingers	Lower Cretaceous.	12	2.0	3	15	5
Tantalus	"	7	3.0	3	16	8
Tantalus Butte	"	3	1.5	3	25	9
Minto	"	....	Insufficient data as to thickness			
Mica Creek	"	....	Insufficient data as to thickness			
Needle Rock (Pelly Canyon)	Tertiary	....	Insufficient data as to thickness			
Total	....	....	....	....	....	....
Aishihik District—						
Nordenskiold	Lower Cretaceous.	....	Insufficient data as to thickness			
Kynocks	"	....	Insufficient data as to thickness			
Peel River District—						
Peel River area	Lower Cretaceous.	....	Insufficient data as to thickness			

LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 1,000 FEET

of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)					
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)	
15	1.0	16,800	15	4.0	67,200	8,400	33,600	II 2
8	0.5	4,480	8	0.5	4,480	2,240	2,240	I 1 and II 2
....	....	21,280	....	....	71,680	10,640	35,840	
8	5.0	44,800	8	10.0	89,600	22,400	44,800	II 2
3	1.0	3,360	3	1.0	3,360	1,680	1,680	II 2
and extent of seams.								
8	2.0	17,920	8	2.0	17,920	8,960	8,960	II 2
....	....	66,080	....	....	110,880	33,040	55,440	
5	1.0	5,600	5	1.0	5,600	2,800	2,800	II 3
8	1.0	8,960	8	2.0	17,920	4,480	8,960	II 3
9	1.0	10,080	9	0.5	5,040	5,040	2,520	II 3
and extent of seams.								
....	....	24,640	....	....	28,560	12,320	14,280	
and extent of seams.								II 3 and I
and extent of seams.								

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TABLE 23.—RESERVES OF YUKON TERRITORY, BASED ON SEAMS NOT LESS

(Thousands

District and Area	Coal-bearing Formation	Area underlain by Coal Formation (sq. miles)		Coal Seams		
		Total	Area used	No.	Aggregate Thickness (feet)	Thickness used (feet)
Old Crow District—						
Old Crow Basin	Tertiary	....	Insufficient data as to thickness			
Porcupine R. Basin	Lower Cretaceous	....				
Arctic Coast District—						
Hershel	Lower Cretaceous	....	Insufficient data as to thickness			
Moose River	"	Extensive	4.0	1	8	8
Glenlyon District	Lower Cretaceous	....	Insufficient data as to thickness			
Dawson District—						
Rock Creek Basin	Tertiary	200	20.0	1	7	5
Ogilvie District—						
Indian River	Tertiary	....	Insufficient data as to thickness			
Kluane District—						
Duke Creek	Tertiary	10	8.0	3	9	5
Sheep Creek	"	4	2.0	1	4	4
Wade Creek	"	....	1.0	1	8	8
Total	....	....	....	....	....	....
Dezadeash District—						
Squaw Creek	Tertiary	....	Insufficient data as to thickness			
Alsek River	"	....				
Kaskawulsh District—						
Jarvis River	Tertiary	....	Insufficient data as to thickness			
Alsek River Extension	"	....				
Watson Lake District—						
Liard River	Tertiary	5	2.0	1	3	3
Bonnet Plume District—						
Bonnet Plume River	Tertiary	425	60.0	2	38	20
GRAND TOTAL	....	....	....	....	....	....

THAN 3 FEET IN THICKNESS TO A MAXIMUM DEPTH OF 1,000 FEET—*Concluded*

of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)					
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage	Probable	Possible (Additional)	
and extent of seams.								
and extent of seams.								
8	2.0	17,920	8	2.0	17,920	8,960	8,960	IV
and extent of seams.								
5	10.0	56,000	5	10.0	56,000	28,000	28,000	IV
and extent of seams.								IV
								IV
5	3.0	16,800	5	5.0	28,000	8,400	14,000	
4	1.0	4,480	4	1.0	4,480	2,240	2,240	
....	....	....	8	1.0	8,960	....	4,480	
....	....	21,280	....	....	41,440	10,640	20,720	
and extent of seams.								
and extent of seams.								
3	1.0	3,360	3	1.0	3,360	1,680	1,680	IV
20	10.0	224,000	20	50.0	1,120,000	112,000	560,000	IV
....	....	434,560	....	....	1,449,840	217,280	724,920	

74634—43½

TABLE 24.—RESERVES OF NORTHWEST TERRITORIES, INCLUDING ARCTIC
DEPTH OF

(Thousands

District and Area	Coal-Bearing Formation	Area underlain by Coal Formation (sq. miles)		Coal Seams		
		Total	Area used	No.	Aggregate Thickness (feet)	Thickness used (feet)
Mainland—						
Fort Norman	Tertiary	....	5	2	6.0	5
Great Bear Lake (Etacho)	Lower Cretaceous	....	2	2	13.0	10
Nahanni River	"	....	3	......	Float	....
Aklavik	"	....	2	......	3.0	3
Horton River 15 m. N.S.	"	....	2	......	4.0	4
Langton Bay	"	....	1	......	Float	3
Total	....	....	....	......	....	....
Arctic Islands—						
Banks Island	Carboniferous	4,000	100	......	3.0	3
Cape Crozier	"	....	1	......	Float	3
Mercy Bay	"	....	1	......	Float	3
Rodd Head	"	....	2	......	Thick Seam	6
Cape Hamilton 3½ m. E.	"	....	2	......	3.0	3
Banks Island	Tertiary	22,000	100	......	3.0	3
Cape Kellett 80 m. N.E.	"	....	1	......	3.0	3
Total	....	....	....	......	....	....
Melville Island	Carboniferous	16,000	210	......	....	3
E. side of Kellett Str.	"	....	1	......	Float	3
Cape Dundas	"	....	1	......	Float	3
Winter Harbour	"	....	1	......	Thin Seams	3
Bridport Inlet	"	....	1	......	Float	3
Skene Bay	"	....	1	......	Float	3
Chevalier Bay	"	....	1	......	Float	3
Cape Grassy	"	....	1	......	Thick Seam	3
Bushman Cove	"	....	1	......	Float	3
Cape Clarendon	"	....	1	......	Float	3
Total	....	....	....	......	....	....
Lougheed Island	Carboniferous	1,000	11	......	Seam and Float	3
Edmund Walker Island	Carboniferous	....	1	......	Float	3
Bathurst Island	Carboniferous	7,680	100	......	....	3
Graham Moore Bay	"	....	1	......	Float	3
Sargent Point	"	....	1	......	Float	3
De La Beche Bay	"	....	1	......	Float	3
Schonberg Point	"	....	1	......	Float	3
Scoresby Bay	"	....	1	......	Float	3
Green River	"	....	1	......	Float	3
Total	....	....	....	......	....	....
Byam Martin Island	Carboniferous	350	5	......	Float	3

ISLANDS, BASED ON SEAMS NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM 1,000 FEET

of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)			Probable	Possible (Additional)	
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage			
5	3	16,800	5	2	11,200	8,400	5,600	IV
10	1	11,200	10	1	11,200	5,600	5,600	IV
....	....	....	3	3	10,080	....	5,040	II 5
3	1	3,360	3	1	3,360	1,680	1,680	II 5
4	1	4,480	4	1	4,480	2,240	2,240	IV
....	....	....	3	1	3,360	....	1,680	IV
....	....	35,840	....	....	43,680	17,920	21,840	
....	....	....	3	100	336,000	....	168,000	II 5
....	....	....	3	1	3,360	....	1,680	II 5
....	....	....	3	1	3,360	....	1,680	II 5
6	1	6,720	6	1	6,720	3,360	3,360	II 5
3	1	3,360	3	1	3,360	1,680	1,680	II 5
....	....	....	3	100	336,000	....	168,000	IV
....	....	....	3	1	3,360	....	1,680	IV
....	....	10,080	....	....	692,160	5,040	346,080	
....	....	....	3	200	672,000	....	336,000	II 5
....	....	....	3	1	3,360	....	1,680	
....	....	....	3	1	3,360	....	1,680	
....	....	....	3	1	3,360	....	1,680	
....	....	....	3	1	3,360	....	1,680	
....	....	....	3	1	3,360	....	1,680	
....	....	....	3	1	3,360	....	1,680	
....	....	....	3	1	3,360	....	1,680	
....	....	....	3	1	3,360	....	1,680	
....	....	....	3	1	3,360	....	1,680	
....	....	....	....	....	702,240	....	351,120	
3	1	3,360	3	10	33,600	1,680	16,800	II 5
....	....	....	3	1	3,360	....	1,680	II 5
....	....	....	3	100	336,000	....	168,000	II 5
....	....	....	3	1	3,360	....	1,680	
....	....	....	3	1	3,360	....	1,680	
....	....	....	3	1	3,360	....	1,680	
....	....	....	3	1	3,360	....	1,680	
....	....	....	3	1	3,360	....	1,680	
....	....	....	3	1	3,360	....	1,680	
....	....	....	....	....	356,160	....	178,080	
....	....	....	3	5	16,800	....	8,400	II 5

TABLE 24—RESERVES OF NORTHWEST TERRITORIES, INCLUDING ARCTIC
DEPTH OF 1,000

(Thousands

District and Area	Coal-Bearing Formation	Area underlain by Coal Formation (sq. miles)		Coal Seams		
		Total	Area used	No.	Aggregate Thickness (feet)	Thickness used (feet)
Amund Ringnes Island	Carboniferous	1,500	10	......	Float	3
Graham Island	Carboniferous	....	1	......	Float	3
Helena Island	Carboniferous	....	1	......	Float	3
Sherard Osborn Island	Carboniferous	2,300	25	......	Float	3
Axel Heiberg	Carboniferous	1,000	10	......	....	3
North End Nansen Fd.	"	....	1	......	Float	3
Mokka Fiord	"	....	1	......	Float	3
Total						
Prince Patrick Island	Carboniferous	1,280	10	......	....	3
Intrepid Inlet	"	....	1	......	Float	3
Total						
Ellesmere Island	Tertiary	....	100	......	....	3
Lake Hazen	"	....	1	......	Float	3
St. Patrick Bay (Conger)	"	....	2	......	Mined	3
Cape Murchison	"	....	2	......	25.0	25
Slidre Fiord	"	....	1	......	Float	3
Bay Fiord	"	....	2	......	6.0	6
Great Bear Cape	"	....	1	......	Float	3
Stenkul Fiord	"	....	2	......	3.5	3
Blaamenden	"	....	1	......	Thin Seams	3
Watercourse Bay	"	....	2	......	25.0	25
Lincoln Bay	"	....	2	......	Thick	10
Total						
Bylot Island—						
Cape Hay	Tertiary	....	2	......	3.0	3
Canada Point	"	....	2	......	3.0	3
Total						
Baffin Island—						
Salmon River (Pond Inlet)	Tertiary	....	2	......	3.0	3
GRAND TOTAL						

ISLANDS, BASED ON SEAMS NOT LESS THAN 3 FEET IN THICKNESS TO A MAXIMUM FEET—*Concluded*

of net tons)

Mineable						Recoverable		A.S.T.M. Classification
Probable			Possible (Additional)			Probable	Possible (Additional)	
Thickness used (feet)	Area (sq. miles)	Tonnage	Thickness used (feet)	Area (sq. miles)	Tonnage			
....	....	....	3	10	33,600	....	16,800	II 5
....	....	....	3	1	3,360	....	1,680	II 5
....	....	....	3	1	3,360	....	1,680	II 5
....	....	....	3	25	84,000	....	42,000	II 5
....	....	....	3	10	33,600	....	16,800	II 5
....	....	....	3	1	3,360	....	1,680	
....	....	....	3	1	3,360	....	1,680	
....	....	....	....	....	40,320	....	20,160	
....	....	....	3	10	33,600	....	16,800	II 5
....	....	....	3	1	3,360	....	1,680	
....	....	....	....	....	36,960	....	18,480	
....	....	....	3	100	336,000	....	168,000	IV
....	....	....	3	1	3,360	....	1,680	II 5
3	1	3,360	3	1	3,360	1,680	1,680	II 5
25	1	28,000	25	1	28,000	14,000	14,000	IV
....	....	....	3	1	3,360	....	1,680	IV
6	1	6,720	6	1	6,720	3,360	3,360	IV
....	....	....	3	1	3,360	....	1,680	IV
3	1	3,360	3	1	3,360	1,680	1,680	IV
....	....	....	3	1	3,360	....	1,680	IV
25	1	28,000	25	1	28,000	14,000	14,000	IV
10	1	11,200	10	1	11,200	5,600	5,600	IV
....	....	80,640	....	....	430,080	40,320	215,040	
3	1	3,360	3	1	3,360	1,680	1,680	II 5
3	1	3,360	3	1	3,360	1,680	1,680	
....	....	6,720	....	....	6,720	3,360	3,360	
3	1	3,360	3	1	3,360	1,680	1,680	II 5
....	....	140,000	....	....	2,489,760	70,000	1,244,880	

APPENDIX B

LIST OF PRINCIPAL CANADIAN PORTS IN THE ST. LAWRENCE AND GREAT LAKES AREA HAVING DOCKS RECEIVING COAL

—	Approximate Storage Capacity		Tonnage Received by Water, April 1944 to March 1945 (See Note A)		Tonnage Received by Water, April 1945 to March 1946 (See Note A)		Vessels Handled (See Note B)	Principal Method of Distribution (See Note C)	
	Commercial Docks	Private Docks	Bituminous	Anthracite	Bituminous	Anthracite		Local	Outside
	Tons	Tons	Tons	Tons	Tons	Tons			
Lake Superior Area—									
Fort William	930,000	1,574,000	2,161,000	6,500	1,299,000	6,000	S.U.V.O. and Bulk	Rail	Rail
Port Arthur		3,000	16,000		33,000		S.U.V.O.	Truck	
Red Rock		50,000			31,000		S.U.V.O.	Truck	
Jack Fish		125,000	254,000		173,000		Bulk		Rail
Marathon		50,000			24,000		S.U.V.O.	Truck	
Michipicoten Harbour	265,000		485,000		400,000		Bulk		Rail
Sault Ste. Marie	95,000	1,165,000	1,979,000	20,000	1,565,000	2,500	S.U.V.O. and Bulk	Truck and Rail	
Lake Huron Area—									
Little Current	500,000		724,000		517,000		Bulk		Rail
Britt	800,000		518,000		431,000		Bulk		Rail
Depot Harbour (Inactive in 1944 and 1945)	875,000						S.U.V.O.		
Parry Sound	5,000		3,000		5,000		S.U.V.O.	Truck	
Port McNicoll		15,000	21,000		15,000		S.U.V.O.	Truck	
Midland	225,000		444,000		376,000	10,000	Bulk	Truck	Rail
Penetang					2,000		S.U.V.O.	Truck	
Collingwood	5,000	4,000	2,000		6,000		S.U.V.O.	Truck	
Meaford	18,000		3,000		3,000		S.U.V.O.	Truck	
Owen Sound	14,000	15,000	29,000		23,000		S.U.V.O.	Truck	
Southampton	5,000		1,500				S.U.V.O.	Truck	
Kincardine	3,000		3,000		3,500		S.U.V.O.	Truck	
Goderich	2,800	27,500	30,000		14,000		S.U.V.O.	Truck	
Sarnia-Windsor Area—									
Point Edward	46,000		44,000		46,000		S.U.V.O.	Truck	Rail
Sarnia	28,000	119,000	236,000		257,000	10,000	S.U.V.O.	Truck	Rail
Wallaceburg	1,000	30,000	40,000		10,000		S.U.V.O.	Truck	
Chatham	7,500		11,000		9,000		S.U.V.O.	Truck	
Windsor	260,000	150,000	571,000		557,000		S.U.V.O.	Truck	
Amherstburg	10,000	30,000	117,000		128,000		S.U.V.O.	Truck	
Lasalle					3,000			Truck	

NOTE A.—While the tonnages shown for bituminous include only water-borne coal, the tonnages for anthracite include approximately 125,000 tons in 1944–45 and 85,000 tons in 1945–46 received at the docks by rail.

NOTE B.—S.U.V.O. indicates location of docks capable of handling self-unloading vessels only. Bulk indicates location of docks capable of handling bulk cargo freighters.

NOTE C.—In the case of coal for local consumption, "truck" includes where applicable, coal consumed at the adjoining plant of private docks.

LIST OF PRINCIPAL CANADIAN PORTS IN THE ST. LAWRENCE AND GREAT LAKES AREA HAVING DOCKS RECEIVING COAL

—	Approximate Storage Capacity		Tonnage Received by Water, April 1944 to March 1945 (See Note A)		Tonnage Received by Water, April 1945 to March 1946 (See Note A)		Vessels Handled (See Note B)	Principal Method of Distribution (See Note C)	
	Commercial Docks	Private Docks	Bituminous	Anthracite	Bituminous	Anthracite		Local	Outside
	Tons	Tons	Tons	Tons	Tons	Tons			
Lake Erie Area—									
Kingsville	15,000	......	13,000	......	11,500	......	S.U.V.O	Truck	
Erieau	200,000	......	478,000	......	497,000	......	Bulk	......	Rail
Port Stanley	175,000	......	203,000	......	174,000	......	S.U.V.O	Truck	Rail
Port Burwell	175,000	......	112,000	......	145,000	......	S.U.V.O	Truck	Rail
Port Maitland	300,000	......	243,000	......	216,000	......	S.U.V.O	......	Rail
Port Colborne	190,000	15,000	241,000	......	209,000	......	S.U.V.O. and Bulk	Truck	Rail
Fort Erie	5,000	......	3,000	......	......	......	Bulk	Truck	
Welland	5,000	50,000	66,000	......	60,000	......	S.U.V.O	Truck	
Thorold	105,000	50,000	183,000	......	180,000	......	S.U.V.O	Truck	
Lake Ontario Area—									
Port Weller	35,000	......	47,000	......	47,000	......	S.U.V.O	Truck	
Hamilton	100,000	900,000	1,563,000	......	1,297,000	10,000	S.U.V.O. and Bulk	Truck	Truck
Toronto	2,605,000	......	1,695,000	87,000	1,531,000	76,000	S.U.V.O. and Bulk	Truck	
Oshawa	29,000	......	57,000	......	65,000	......	S.U.V.O	Truck	Truck
Port Hope	14,500	7,000	19,000	......	15,000	......	S.U.V.O	Truck	
Cobourg	11,000	......	10,000	700	9,000	60	S.U.V.O	Truck	
Trenton	80,000	......	32,000	......	36,000	......	S.U.V.O	Truck	Truck
Belleville	65,000	......	34,000	......	34,000	......	S.U.V.O	Truck	
Picton	12,000	......	19,000	2,000	11,000	1,000	S.U.V.O	Truck	
Napanee	20,000	......	20,000	......	17,000	......	Bulk	Truck	Truck
Kingston	72,000	10,000	83,000	27,000	67,000	27,000	S.U.V.O	Truck	
St. Lawrence Area—									
Gananoque	6,200	......	6,000	3,000	7,000	3,000	S.U.V.O	Truck	
Brockville	34,000	......	24,000	11,000	20,000	11,000	S.U.V.O	Truck	
Prescott	300,000	8,000	629,000	46,000	579,000	30,000	S.U.V.O	Truck	Rail
Cardinal	15,000	30,000	51,000	4,000	65,000	3,000	S.U.V.O	Truck	
Cornwall	25,000	60,000	64,000	2,000	81,000	2,000	S.U.V.O	Truck	
Montreal	2,230,000	670,000	1,770,000	84,000	1,880,000	68,000	Bulk	Truck	Rail
Beauharnois	......	......	20,000	......	22,000	......	Bulk	Truck	
Sorel	95,000	......	31,000	......	42,000	......	Bulk	Truck	

Three Rivers	375,000	...	313,000	...	340,000	...	Bulk	Truck	Rail
Levis	9,000	Inactive	3,000	...	2,500	...	Bulk	Truck	
Quebec City	201,000	80,000	289,000	53,000	254,000	48,000	Bulk	Truck	Rail
Port Alfred	...	164,000	183,000	...	5,000	...	Bulk	Truck	Rail
Chicoutimi	65,000	...	64,000	12,000	27,000	11,000	Bulk	Truck	
Baie Comeau	...	...	24,000	...	13,000	...	Bulk	Truck	
Clarke City	...	4,000	1,000	...	1,300	...	Bulk	Truck	

NOTE A.—While the tonnages shown for bituminous include only water-borne coal the tonnages for anthracite included approximately 125,000 tons in 1944–45 and 85,000 tons 1945–46 received at the docks by rail.

NOTE B.—S.U.V.O. indicates location of docks capable of handling self-unloading vessels only. Bulk indicates location of docks capable of handling bulk cargo freighters.

NOTE C.—In the case of coal for local consumption "truck" includes where applicable, coal consumed at the adjoining plant of private docks.

APPENDIX C

USE OF MAJOR ENERGY SOURCES: 1926–1945

(Trillions of B.t.u.)

Year	Water Power at Yearly Average Coal Equivalent[1]	Coal[2]			Petroleum Fuels[5]			Natural Gas[6]	Total[7] Sum of Foregoing Fuels		
	Domestic	Domestic[3]	Imports[4]	Total[2]	Domestic	Imports	Total[5]	Domestic	Domestic	Imports	Total
1926	261	379	464	844	2	107	109	21	664	571	1,234
1927	280	394	501	895	3	123	126	23	701	624	1,324
1928	314	409	464	873	4	149	153	24	751	614	1,365
1929	337	405	500	906	7	178	185	31	780	678	1,458
1930	326	347	514	861	9	171	180	32	714	685	1,399
1931	295	288	357	645	9	161	171	28	620	518	1,138
1932	273	273	324	597	6	154	160	25	577	478	1,055
1933	279	280	302	581	7	154	161	25	591	455	1,046
1934	318	327	356	683	9	163	172	25	679	519	1,198
1935	341	327	327	654	9	173	182	27	703	500	1,204
1936	360	356	353	710	9	179	188	30	756	532	1,288
1937	401	375	390	764	18	189	207	35	828	579	1,407
1938	391	340	343	683	42	176	217	36	809	519	1,328
1939	415	370	399	769	47	186	233	38	870	585	1,455
1940	459	415	468	882	52	212	263	44	970	679	1,649
1941	542	427	546	972	61	237	297	47	1,076	782	1,858
1942	615	437	668	1,104	62	224	286	49	1,163	892	2,055
1943	666	396	754	1,150	60	231	291	48	1,170	985	2,155
1944	656	383	764	1,146	61	259	320	48	1,148	1,023	2,170
1945*	607	375	682	1,057	51	271	322	57	1,090	953	2,043

[1] Output of central electric stations generated by water, less exports, plus power generated and used by the manufacturing and mining industries. Primary power is calculated at the coal equivalent, based on the average efficiency of central electric stations in the United States as reported by the Edison Electric Institute. Because of increased efficiency in the utilization of coal this average decreased from the equivalent of 1.95 lbs. of coal per kilowatt hour in 1926 to the equivalent of 1.31 lbs. in 1945. Secondary power sold by central electric stations is calculated at its actual B.t.u. equivalent of 3,415 B.t.u. per kilowatt hour.

[2] Includes anthracite coal, bituminous coal, sub-bituminous coal, lignite coal and imported coke. The unit heat values employed are: anthracite, 27,200,000 B.t.u. per ton; bituminous, 26,200,000 B.t.u. per ton; sub-bituminous and lignite, 20,000,000 B.t.u. per ton; coke, 26,000,000 B.t.u. per ton.

[3] Sum of sales by Canadian coal mines, colliery consumption, coal supplied to employees and coal used in making coke, etc., less tonnage bunkered and exported.

[4] Imported for consumption. Deductions have been made to take account of foreign coal re-exported and bunkered.

[5] The coal equivalent of the sum of gasoline, fuel and gas oils and kerosene estimated by the D.B.S. and converted to B.t.u. on the basis of 1 ton of coal equals 26,000,000 B.t.u. plus petroleum coke imports consumed as fuel calculated at the rate of 30,000,000 B.t.u. per ton.

[6] Total production. The unit heat values employed are 1,075 B.t.u. per cubic foot.

[7] Including water power calculated at the yearly average coal equivalent.

* Preliminary.

SOURCE: The Bank of Canada Statistical Summary, October-November, 1946.

APPENDIX D

STATISTICS OF COAL CONSUMPTION

In the tables that follow are presented estimates of annual coal consumption for the four regions into which Canada has been divided for purposes of the discussion of coal markets. The figures are for the years 1937 and 1939 to 1945 inclusive, and are classified by country of origin of the coal and to some extent by the purpose for which the coal was consumed. The estimates are of actual consumption and, therefore, are not directly comparable with figures based on coal available for consumption. Figures for coal consumption and for coal available for consumption differ by the extent to which coal stocks are increased or depleted. Since coal stocks in Canada may, under unusual conditions, vary from year-end to year-end by 3,000,000 tons or more, coal consumption in any one year may differ considerably from coal available for consumption in the same year.

To a very considerable extent the tables that follow are based on material which was collected by the Dominion Bureau of Statistics, principally for the office of the Coal Controller. The Royal Commission on Coal is much indebted to both these organizations for making that material available, but the responsibility for the use made of it rests entirely with the Commission. The Commission, therefore, emphasizes that the figures presented are estimates only and are known to be incomplete in some respects. This is particularly true for the years 1937 and 1939, for which much less actual consumption data are available. It is believed, however, that the figures are sufficiently accurate to be of assistance in analysing the Canadian coal market. For the benefit of any who wish to use them extensively, a few notes on the manner in which they have been prepared and some of the defects known to exist in them follow.

(1) It is stressed again that the figures for 1937 and 1939 are much less reliable than those for the later years. During the later years returns were made to the Dominion Bureau of Statistics by retail dealers and by large consumers of coal for the use of the Coal Controller. In the years 1937 and 1939 similar source material was not available. The estimates for those two years are, therefore, based largely on figures of coal consumption as shown in Census of Industry reports and on returns made by the railroads, with the retail figures obtained by difference.

(2) For all years except 1940 the figures are on a calendar year basis. The retail and industrial figures shown for 1940 are actually for the twelve months from April, 1940, to March, 1941, inclusive.

(3) Under the heading of Retail Sales are included all sales of coal made at retail prices and also all direct sales of coal by collieries for domestic use, both to their own employees and to others. Most of the coal thus sold was undoubtedly used for domestic purposes, but there is included an unknown amount used by small commercial establishments and small off-siding industry.

(4) During many of the years covered by the figures it was a practice in some areas to mix together in varying percentages American and Welsh blower anthracite and to report the mixture as Welsh anthracite. For this reason the figures tend to show rather more United Kingdom anthracite and less United States anthracite consumed than was in fact the case.

(5) Table 3, in which are given more detailed figures of retail sales of coal and coke in Ontario and Quebec, is based, insofar as the years 1928 to 1932, inclusive, are concerned, on the publication "Fuels Distributed for Domestic Heating in Manitoba, Ontario and Quebec, 1928 to 1932", by the Dominion Fuel Board in co-operation with the Mines Branch, Department of Mines.

(6) From April 1940 on, all industrial consumers known to be using more than 500 tons annually reported their coal consumption on a monthly basis to the Dominion Bureau of Statistics for the use of the Office of the Coal Controller, and it is on these reports that the industrial consumption estimates were based. It is estimated that these reports covered 94 per cent of total industrial consumption and the totals reported were inflated accordingly. To these totals were then added the figures of colliery consumption for power purposes and for making briquettes.

(7) There is duplication involved in the treatment of briquettes. Coal used for briquette-making is included in industrial consumption, whereas briquettes sold retail are included in retail sales. Since the total production and most of the consumption of briquettes is on the Prairies, it is only for that area that this comment is relevant.

(8) In most cases the export figures have been based on the External Trade Branch returns, although an adjustment has been made in the regional tables to show exports in the region of origin rather than in the region through whose ports the coal was actually exported.

(9) Prior to 1942 there is little information available on coal deliveries to ships' bunkers, except insofar as the deliveries were direct from mines. The consumption estimates for bunkers for the earlier years are therefore based on very limited information.

(10) It would appear that there is some consumption of coal which is overlooked in the tables that follow. The use of coal by commercial establishments, such as large apartment blocks and stores, is probably not included, except insofar as it was purchased at retail prices. Also, a considerable percentage of coal sold to the Department of Munitions and Supply on Armed Service contracts is probably not included. The magnitude of the error produced by these omissions can only be roughly estimated, but it is not believed to be sufficiently large to reduce seriously the value of these figures for any purposes to which they might reasonably be put.

APPENDIX D

TABLE 1.—CONSUMPTION OF COAL AND COKE IN THE MARITIMES, BY CALENDAR YEARS

(In thousands of net tons)

—	1937	1939	1940	1941	1942	1943	1944	1945
Retail—								
Anthracite—United Kingdom	113	103	103	103	120	87	56	73
United States	29	33	34	36	50	54	71	73
Bituminous and Lower Rank—Canadian	955	1,003	1,150	1,263	1,249	1,250	1,185	1,220
Bituminous—United Kingdom	47	35	18	15	6	5	2	....
United States	4	5	19	5	4	7	9	8
Coke from Coal	60	54	63	77	72	95	121	163
Industrial—								
Anthracite—United Kingdom	1	1	1	1	....	....	1	1
Bituminous and Lower Rank—Canadian	1,439	1,231	1,396	1,551	1,637	1,620	1,657	1,598
Bituminous—United States	2	2	2	10	9	22	40	18
Coke from Coal	434	382	544	514	584	470	476	455
Coke and Gas Plants—								
Bituminous and Lower Rank—Canadian	700	644	927	855	958	856	887	838
Railways—								
Bituminous and Lower Rank—Canadian	728	678	916	1,092	1,267	1,282	1,072	952
Bituminous—United States	1	1	1	2	11	57	236	348
Bunkers—								
Bituminous and Lower Rank—Canadian	370	410	514	544	695	589	341	384
Bituminous—United Kingdom	5	4	4	4	6	10	1	1
United States	12	12	12	11	1	1	209	350
Total—								
Anthracite—United Kingdom	114	104	104	104	120	87	57	74
Anthracite—United States	29	33	34	36	50	54	71	73
Bituminous and Lower Rank—Canadian	4,192	3,966	4,903	5,305	5,806	5,597	5,142	4,992
Bituminous—United Kingdom	52	39	22	19	12	15	3	1
Bituminous—United States	19	20	34	28	25	87	494	724
Coke from Coal	494	436	607	591	656	565	597	618
Exports—								
Bituminous and Lower Rank—Canadian	204	227	311	356	506	497	495	460

TABLE 2.—CONSUMPTION OF COAL AND COKE IN ONTARIO AND QUEBEC BY CALENDAR YEARS

(In thousands of net tons)

—	1937	1939	1940	1941	1942	1943	1944	1945
Retail—								
Anthracite—United Kingdom	1,375	1,212	1,040	969	453	501	263	66
United States	1,747	2,341	2,223	2,620	3,905	3,666	3,433	3,107
Bituminous and Lower Rank—Canadian	587	590	614	651	502	165	66	244
Bituminous—United Kingdom	199	60	33	19	1	....	....	....
United States	2,010	2,100	2,203	2,469	3,048	4,018	3,393	3,542
Coke from Coal	1,000	1,153	1,134	968	692	957	1,287	1,988
Industrial—								
Anthracite—United Kingdom	68	68	65	69	46	7	19	12
United States	57	58	74	99	180	196	162	157
Bituminous and Lower Rank—Canadian	1,713	1,650	1,793	1,568	1,243	962	607	374
Bituminous—United Kingdom	5	5	6	17	1	1	....	....
United States	3,468	3,250	3,635	4,825	6,250	7,089	7,357	6,850
Coke from Coal	1,268	1,080	1,698	1,974	2,509	2,539	2,490	2,480
Coke and Gas Plants—								
Bituminous and Lower Rank—Canadian	196	199	249	239	171	36	24	21
Bituminous—United States	2,399	2,195	2,713	2,895	3,019	3,574	4,115	4,015
Railways—								
Bituminous and Lower Rank—Canadian	1,157	1,469	1,593	1,263	629	258	103	122
Bituminous—United States	3,005	2,720	3,237	4,619	5,957	7,205	7,170	7,296
Bunkers—								
Bituminous and Lower Rank—Canadian	61	68	60	63	44	16	27	9
Bituminous—United States	460	460	460	460	517	519	640	955
Total—								
Anthracite—United Kingdom	1,443	1,280	1,105	1,038	499	508	282	78
Anthracite—United States	1,804	2,399	2,297	2,719	4,085	3,862	3,595	3,264
Bituminous and Lower Rank—Canadian	3,714	3,976	4,309	3,784	2,589	1,437	827	770
Bituminous—United Kingdom	124	65	39	36	2	1	....	....
Bituminous—United States	11,342	10,725	12,248	15,268	18,791	22,405	22,675	22,658
Coke from Coal	2,268	2,233	2,832	2,942	3,201	3,496	3,777	4,468
Exports—								
Coke from Coal	15	24	9	2	3	2	1	2

TABLE 3.—RETAIL SALES OF COAL AND COKE IN ONTARIO AND QUEBEC BY CALENDAR YEARS

(In thousands of net tons)

—	1928	1929	1930	1931	1932	1937	1939	1940	1941	1942	1943	1944	1945
Anthracite—													
United States—Domestic Sizes	2,739	2,742	2,411	1,907	1,511	1,747	2,341	1,965	2,303	3,357	2,974	2,787	2,347
Buckwheat and Smaller	213	234	245	227	180			258	317	548	692	646	760
United Kingdom—Domestic Sizes	357	365	422	479	619			368	370	76	92	24	....
Buckwheat and Smaller	192	332	458	508	620	1,375	1,212	672	599	377	409	239	66
Other Foreign—All Sizes	3	50	148	102	37			....	....	....	....	....	....
Total Anthracite	3,504	3,723	3,684	3,223	2,967	3,122	3,553	3,263	3,589	4,358	4,167	3,696	3,173
	(55.4%)	(56.1%)	(55.4%)	(52.6%)	(49.3%)	(45.7%)	(47.6%)	(45.0%)	(46.6%)	(50.7%)	(44.8%)	(43.8%)	(35.5%)
Other Coal—													
United States—High Volatile Bituminous	800	784	834	853	852			1,495	1,701	2,092	2,861	2,465	2,674
Low Volatile Bituminous	437	455	443	410	402	2,010	2,100	670	723	882	1,063	848	789
Cannel, Smithing and Briquettes	23	25	20	12	12			38	45	74	94	80	80
United Kingdom—Bituminous	21	37	17	36	45	119	60	33	19	1	....	....	....
Canadian—Bituminous	369	340	370	302	327			544	519	315	161	56	52
Briquettes	51	45	37	30	33	587	590	21	31	34	1	3	6
Sub-bituminous	55	53	36	32	26			49	101	153	3	7	185
Total Other Coal	1,756	1,739	1,757	1,675	1,697	2,716	2,750	2,850	3,139	3,551	4,183	3,459	3,786
	(27.7%)	(26.2%)	(26.4%)	(27.4%)	(28.2%)	(39.7%)	(36.9%)	(39.3%)	(40.8%)	(41.3%)	(44.9%)	(41.0%)	(42.3%)
Coke from Coal—													
Coke made in Canada	563	545	684	777	866	....	....	900	806	488	572	901	1,156
Coke made in U.S.	510	629	527	449	490[1]	....	....	234	162	204	385	386	832
Total Coke	1,073	1,174	1,211	1,226	1,356	1,000	1,153	1,134	968	692	957	1,287	1,988
	(16.9%)	(17.7%)	(18.2%)	(20.0%)	(22.5%)	(14.6%)	(15.5%)	(15.7%)	(12.6%)	(8.0%)	(10.3%)	(15.2%)	(22.2%)
Grand Total	6,333	6,636	6,652	6,124	6,020	6,838	7,456	7,247	7,696	8,601	9,307	8,442	8,947
	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	100%)	(100%)

[1] Includes 28 thousand tons of United Kingdom Coke.

TABLE 4.—CONSUMPTION OF COAL AND COKE IN THE PRAIRIES BY CALENDAR YEARS

(In thousands of net tons)

—	1937	1939	1940	1941	1942	1943	1944	1945
Retail—								
Anthracite—United Kingdom	...	...	1	1	...	...	...	...
United States	4	3	4	3	2	2	...	1
Bituminous and Lower Rank—Canadian	2,612	2,445	2,546	2,780	3,109	3,405	3,082	3,308
Bituminous—United States	45	40	32	32	48	139	93	107
Coke from Coal	60	65	59	62	68	66	57	63
Industrial—								
Anthracite—United States	12	6	8	8	10	10	10	10
Bituminous and Lower Rank—Canadian	977	950	1,053	1,301	1,446	1,508	1,561	1,526
Bituminous—United States	7	10	15	7	3	27	35	33
Coke from Coal	28	28	16	19	23	24	23	25
Coke and Gas Plants—								
Bituminous and Lower Rank—Canadian	129	163	165	180	181	172	142	125
Bituminous—United States	26	1	3	...	...	5	34	17
Railways—								
Bituminous and Lower Rank—Canadian	2,299	2,239	2,555	3,081	2,970	2,606	2,919	2,949
Bituminous—United States	43	37	13	13	208	886	943	853
Total—								
Anthracite—United Kingdom	...	...	1	1	...	...	...	...
United States	16	9	12	11	12	12	10	11
Bituminous and Lower Rank—Canadian	6,017	5,797	6,319	7,342	7,706	7,691	7,704	7,908
Bituminous—United States	121	88	63	52	259	1,057	1,105	1,010
Coke from Coal	88	93	75	81	91	90	80	88
Exports—								
Bituminous and Lower Rank—Canadian	48	36	38	36	102	462	298	197

TABLE 5.—CONSUMPTION OF COAL AND COKE IN BRITISH COLUMBIA BY CALENDAR YEARS

(In thousands of net tons)

—	1937	1939	1940	1941	1942	1943	1944	1945
Retail—								
Bituminous and Lower Rank—Canadian	500	485	558	613	670	717	743	785
Bituminous—United States	4	......	1	1	1	1	......	......
Coke from Coal	27	23	23	25	33	23	24	31
Industrial—								
Bituminous and Lower Rank—Canadian	390	375	380	344	474	491	452	428
Coke from Coal	99	104	146	144	183	169	144	145
Coke and Gas Plants—								
Bituminous and Lower Rank—Canadian	166	171	192	236	257	263	258	232
Railways—								
Bituminous and Lower Rank—Canadian	285	257	245	276	356	474	437	435
Bituminous—United States	......	......	......	......	......	1	......	10
Bunkers—								
Bituminous and Lower Rank—Canadian	200	241	176	99	180	81	35	22
Total—								
Bituminous and Lower Rank—Canadian	1,541	1,529	1,551	1,568	1,937	2,026	1,925	1,902
Bituminous—United States	4	......	1	1	1	2	......	10
Coke from Coal	126	127	169	169	216	192	168	176
Exports—								
Bituminous and Lower Rank—Canadian	103	114	156	140	208	151	217	183
Coke from Coal	36	26	27	37	42	45	39	33